W. B. No. 630.

U. S. DEPARTMENT OF AGRICULTURE

WEATHER BUREAU

CHARLES F. MARVIN, Chief

MONTHLY WEATHER REVIEW

VOLUME 45, No. 10

OCTOBER, 1917

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

OCTOBER, 1917.

CONTENTS.

NOTICE TO CONTRIBUTORS.

Contributions intended for publication in any given issue of the MONTHLY WEATHER REVIEW (e. g., January) should be in the hands of the editor before the end of the next following month (e. g., February), if no illustrations are required. When the paper is illustrated, the manuscript and the copy for illustrations must be submitted much earlier, in order to permit copy being prepared for the engraver by the end of the month.

REPRINTS are made up without covers in the original size and pagination of the REVIEW. They will not be furnished unless specifically REQUESTED WHEN THE MANUSCRIPT IS SUBMITTED.

MONTHLY WEATHER REVIEW

Cleveland Abbe, jr., Editor.

Vol. 45, No. 10.
W. B. No. 630.

OCTOBER, 1917.

Closed Dec. 3, 1917
Issued Dec. 31, 1917

INTRODUCTION.

As explained in this Introduction during 1914, the Monthly Weather Review now takes the place of the Bulletin of the Mount Weather Observatory and of the voluminous publication of the climatological service of the Weather Bureau. The Monthly Weather Review contains contributions from the research staff of the Weather Bureau and also special contributions of a general character in any branch of meteorology and climatology.

Supplements to the Monthly Weather Review are published from time to time.

The climatological service of the Weather Bureau is maintained in all its essential features, but its publications, so far as they relate to purely local conditions, are incorporated in the monthly reports "Climatological Data" for the respective States, Territories, and colonies.

Beginning August, 1915, the material for the Monthly Weather Review has been prepared and classified as follows:

Section 1.—*Aerology.*—Data and discussions relative to the free atmosphere.

Section 2.—*General meteorology.*—Special contributions by any competent student bearing on any branch of meteorology and climatology, theoretical or otherwise.

Section 3.—*Forecasts and general conditions of the atmosphere.*

Section 4.—*Rivers and floods.*

Section 5.—*Seismology.*—Results of observations by Weather Bureau observers and others as reported to the Washington office.

Section 6.—*Bibliography.*—Recent additions to the Weather Bureau library; recent papers bearing on meteorology.

Section 7.—*Weather of the month.*—Summary of local weather conditions; climatological data from regular Weather Bureau Stations; tables of accumulated and excessive precipitation; data furnished by the Canadian Meteorological Service; monthly charts Nos. 1, 2, 3, 4, 5, 6, 7, 8, the same as hitherto; Meteorological Summary and chart No. 9 of the North Atlantic Ocean for this month in 1916. Owing to the fact that ocean meteorological data are frequently not available for a considerable time after the close of the month to which they relate, the chart and text matter in connection therewith appear one year late.

In general, appropriate officials prepare the seven sections above enumerated; but *all students of atmospherics are cordially invited to contribute such additional articles as seem to be of value.*

The voluminous tables of data and text relative to local climatological conditions, that during recent years were prepared by the 12 respective "district editors" are omitted from the Monthly Weather Review, but collected and published by States at selected section centers in the monthly reports already mentioned.

The data needed in Section 7 can only be collected and prepared several weeks after the close of the month designated on the title-page; hence the Review as a whole can only issue from the press within about eight weeks from the end of that month.

It is hoped that the meteorological data hitherto contributed by numerous independent services will continue as in the past. Our thanks are specially due to the directors and superintendents of the following:

The Meteorological Service of the Dominion of Canada.
The Meteorological Service of Cuba.
The Meteorological Observatory of Belén College, Habana.
The Government Meteorological Office of Jamaica.
The Meteorological Service of the Azores.
The Meteorological Office, London.
The Danish Meteorological Institute.
The Physical Central Observatory, Petrograd.
The Philippine Weather Bureau.

The Weather Bureau desires that the Monthly Weather Review shall be a medium of publication for contributions within its field, but such publication is not to be construed as official approval of the views expressed.

SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING OCTOBER, 1917.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Weather Bureau, Washington, Nov. 30, 1917.]

For a description of instrumental exposures and an account of the methods of obtaining and reducing the measurements the reader is referred to the REVIEW for January, 1917, **45**:2.

The monthly means and departures from normal values are given in Table 1 show that direct solar radiation averaged above normal intensity at Madison and Santa Fe, and close to normal at Washington and Lincoln.

Table 3 shows a deficiency in the total radiation for the month of nearly 9 per cent at Washington and 14 per cent at Madison as compared with the October normals for these stations.

Skylight polarization measurements obtained at Wash-Ogton on seven days give a mean of 51 per cent with a waximum of 63 per cent. These are below the average tactober values for Washington. The measurements obmined at Madison on 3 days give a mean of 67 per cent, niith a maximum of 71 per cent on the 1st.

TABLE 1.—*Solar radiation intensities during October, 1917.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Oct. 1	......	1.20	1.11	1.02	0.91	0.80	0.71	0.64	......	......
2	......	1.25	1.21	1.12	1.03	0.96	0.90	0.84	0.79	......
3	......	1.27	1.06	0.99	0.93	0.87	0.82	0.77	0.71	0.66
5	......	1.09	......	......	......	......	......	......	......	......
6	......	1.37	1.24	1.08	0.85	0.72	0.58	0.51	......	......
13	......	1.33	1.25	1.15	1.05	0.97	0.90	0.85	0.82	......
22	......	......	0.96	0.85	0.74	0.65	0.60	0.56	......	......
26	......	1.26	1.01	......	......	......	......	......	......	......
27	......	......	1.08	......	......	......	......	......	......	......
31	......	......	1.14	1.07	0.97	......	......	0.82	......	0.72
Means	......	**1.25**	**1.12**	**1.04**	**0.93**	**0.83**	**0.75**	**0.71**	**0.77**	**(0.69)**
Departure from 9-year normal	......	**+0.02**	**+0.01**	**+0.01**	**±0.00**	**−0.03**	**−0.07**	**−0.04**	**+0.01**	**−0.06**
P. M.										
Oct. 2	......	1.25	0.99	0.94	0.89	0.82	0.76	0.73	0.69	0.65
3	......	1.28	......	......	......	......	......	......	......	......
25	......	......	......	......	0.80	0.77	......	......	......	......
31	......	......	......	......	......	......	0.84	0.76	......	......
Means	......	**(1.26)**	**(0.99)**	**(0.94)**	**(0.84)**	**(0.80)**	**(0.80)**	**(0.74)**	**(0.69)**	**(0.65)**
Departure from 9-year normal	......	**+0.02**	**−0.14**	**−0.12**	**−0.07**	**−0.03**	**+0.03**	**+0.02**	**+0.02**	**+0.03**

TABLE 1.—*Solar radiation intensities during October, 1917*—Continued.

Madison, Wis.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Oct. 1	......	1.40	1.21	......	......	......	......	......	......	......
6	......	1.31	1.27	1.15	1.06	0.99	......	......	......	......
8	......	......	......	......	......	1.14	1.09	1.04	......	......
13	......	......	1.37	1.30	1.24	1.17	......	......	......	......
16	......	1.42	1.28	1.24	1.16	1.08	1.01	......	......	......
27	......	1.37	......	......	......	......	......	......	......	......
Monthly means	......	**1.38**	**1.28**	**1.23**	**1.15**	**1.10**	**(1.05)**	**(1.04)**	......	......
Departure from 8-year normals	......	**+0.13**	**+0.12**	**+0.14**	**+0.12**	**+0.16**	**+0.20**	**+0.31**	......	......
P. M.										
Oct. 1	......	1.41	......	......	......	......	......	......	......	......
15	......	......	1.28	1.18	1.11	1.04	0.98	0.93	......	......
16	......	......	1.18	......	......	0.93	......	......	......	......
Means	......	**(1.41)**	**(1.23)**	**(1.18)**	**(1.11)**	**(0.98)**	**(0.98)**	**(0.93)**	......	......
Departures from 8-year normals	......	**+0.09**	**+0.07**	**+0.09**	**+0.11**	**+0.01**	**+0.03**	**+0.13**	......	......

Lincoln, Nebr.

Date.	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.										
Oct. 9	......	1.31	1.24	1.19	......	......	......	......	......	......
11	......	......	......	......	......	0.95	......	......	......	......
12	......	1.50	1.44	1.36	1.28	1.20	1.12	1.04	0.96	......
13	......	1.21	1.21	1.16	1.07	0.98	......	......	......	......
15	......	1.25	1.16	1.06	1.00	0.88	......	......	......	......
26	......	......	1.37	1.31	1.23	......	......	......	......	......
27	......	1.40	1.31	1.21	1.13	1.06	0.98	......	......	......
Means	......	**1.33**	**1.29**	**1.22**	**1.14**	**1.01**	**(1.05)**	**(1.04)**	**(0.96)**	......
Departure from 3-year normal	......	**−0.04**	**−0.02**	**−0.02**	**−0.02**	**−0.06**	**+0.03**	**+0.09**	**+0.06**	......
P. M.										
Oct. 2	......	1.18	......	......	......	......	......	......	......	......
3	......	1.22	1.10	1.01	0.95	0.89	0.83	0.78	0.72	0.67
4	......	1.28	1.20	1.11	1.03	0.96	0.91	0.87	......	......
10	......	1.31	1.20	......	......	......	......	......	......	......
12	......	1.50	1.39	1.25	1.06	......	......	......	......	......
14	......	1.29	1.16	1.05	0.95	......	......	......	......	......
15	......	......	1.17	1.09	1.01	0.95	0.89	0.83	0.78	0.73
22	......	......	......	......	......	......	......	......	......	0.92
23	......	......	1.22	......	......	1.09	1.06	1.02	......	......
27	......	......	1.23	......	......	......	......	......	......	......
31	......	......	1.34	......	......	......	......	......	......	......
Means	......	**1.30**	**1.22**	**1.10**	**1.00**	**0.97**	**0.92**	**0.88**	**(0.75)**	**0.77**
Departure from 3-year normal	......	**−0.06**	**−0.02**	**−0.06**	**−0.08**	**−0.06**	**−0.05**	**−0.04**	**−0.11**	**−0.07**

TABLE 1.—*Solar radiation intensities during October, 1917*—Continued

Santa Fe, N. Mex.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Oct. 5	......	......	......	......	1.24	1.19	1.13	1.08	1.06	......
9	......	1.57	......	1.37	1.29	1.27	1.21	1.15	1.07	......
15	......	1.50	......	......	......	1.21	1.15	1.09	1.04	......
16	......	1.49	......	......	1.21	1.15	1.11	1.06	......	......
18	......	1.50	1.40	......	......	1.17	1.10	1.03	0.97	0.91
19	......	1.52	1.45	1.40	1.34	1.30	1.25	1.21	1.17	1.14
20	......	1.53	1.45	1.39	1.33	1.27	1.27	1.22	1.18	1.13
22	......	1.48	1.44	1.40	......	1.34	1.29	1.22	1.15	......
27	......	1.51	1.38	1.31	1.25	1.20	......	......	1.09	......
30	......	1.53	1.44	......	......	1.31	......	......	1.24	......
Means	......	**1.51**	**1.43**	**1.37**	**1.28**	**1.24**	**1.19**	**1.13**	**1.11**	**1.06**
Departure from 5-year normal	......	**+0.03**	**+0.06**	**+0.05**	**+0.05**	**+0.06**	**+0.04**	**−0.01**	**+0.01**	**−0.02**
P. M.										
Oct. 8	......	......	1.39	1.27	1.26	1.17	......	......	......	......
9	......	1.52	1.46	1.39	1.32	1.25	1.18	1.13	......	......
11	......	1.52	1.41	1.31	1.24	1.18	1.13	......	......	......
16	......	......	1.42	1.34	1.27	1.21	......	......	......	......
18	......	1.47	1.34	......	......	......	......	......	......	......
19	......	1.49	......	1.32	1.23	......	1.13	......	......	......
20	......	......	1.42	......	......	......	......	......	......	......
22	......	......	1.39	......	......	......	......	......	......	......
27	......	......	1.34	......	......	......	......	......	......	......
30	......	......	1.45	1.38	1.32	1.25	1.20	1.15	1.11	......
Means	......	**1.50**	**1.40**	**1.34**	**1.27**	**1.21**	**1.16**	**(1.14)**	**(1.11)**	......
Departure from 2-year normal	......	+0.03	+0.02	+0.04	+0.04	+0.06	+0.07	+0.13	+0.26	......

TABLE 2.—*Vapor pressures at pyrheliometric stations on days when solar radiation intensities were measured.*

Washington, D. C.			Madison, Wis.			Lincoln, Nebr.			Santa Fe, N. Mex.		
Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.	Dates.	8 a.m.	8 p.m.
1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*	1917.	*mm.*	*mm.*
Oct. 1	6.76	6.02	Oct. 1	6.02	6.50	Oct. 2	7.87	8.18	Oct. 5	5.79	4.95
2	6.76	7.29	6	4.95	4.95	3	7.04	8.48	8	5.16	5.56
3	7.57	9.14	8	3.63	3.30	4	7.87	7.29	9	4.95	3.63
5	10.59	10.97	13	2.62	3.63	9	6.76	4.37	11	3.00	4.17
6	6.50	4.75	15	4.37	4.57	10	4.57	4.95	15	3.63	4.95
13	3.81	5.56	16	3.99	3.99	11	5.16	2.36	16	4.17	4.17
22	4.95	5.36	27	3.81	3.45	12	2.26	1.52	18	2.36	1.60
25	5.16	5.36	......	......	......	13	3.15	4.57	19	2.16	2.74
26	5.36	7.57	......	......	......	14	3.81	5.16	20	2.74	3.15
27	7.57	12.24	......	......	......	15	5.16	5.16	22	2.36	3.63
31	2.62	3.30	......	......	......	22	3.81	3.45	27	2.36	2.87
						23	2.87	2.74	30	1.78	2.36
						26	3.63	6.02	......	......	......
						27	3.15	3.99	......	......	......
						31	2.49	2.74	......	......	......

TABLE 3.—*Daily totals and departures of solar and sky radiation during October, 1917.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.		Departures from normal.		Excess or deficiency since first of month.	
	Washington.	Madison.	Washington.	Madison.	Washington.	Madison.
1917.	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*	*calories.*
Oct. 1	307	422	−33	137	−33	137
2	442	292	106	11	73	148
3	424	146	92	−132	165	16
4	356	290	28	16	193	32
5	292	203	−32	−68	161	−39
6	344	376	23	108	184	72
7	414	339	95	74	279	146
8	231	345	−85	84	194	230
9	58	61	−255	−197	−61	33
10	242	142	−69	−113	−130	−80
11	278	27	−30	−225	−160	−305
12	104	90	−202	−159	−362	−464
13	414	310	111	64	−251	−400
14	401	286	100	43	−151	−357
15	363	361	65	121	−86	−236
16	297	344	1	107	−85	−129
17	349	48	55	−186	−30	−315
18	71	46	−220	−186	−250	−501
19	144	117	−145	−112	−395	−613
20	379	91	92	−135	−303	−748
Decade departure					**−173**	**−668**
21	384	270	99	47	−204	−701
22	330	167	48	−53	−156	−754
23	215	231	−65	13	−221	−741
24	48	281	−230	66	−451	−675
25	291	268	15	56	−436	−619
26	336	38	62	−172	−374	−791
27	294	239	22	31	−352	−760
28	333	60	63	−146	−289	−906
29	88	94	−180	−110	−469	−1,016
30	81	192	−185	−10	−654	−1,026
31	292	224	27	23	−627	−1,003
Decade departure					**−324**	**−255**
Excess or deficiency since first of year: calories					**−6,608**	**+677**
Excess or deficiency since first of year: per cent					−5.6	+0.6

ATMOSPHERIC OPTICAL DISTURBANCES, FALL OF 1911 TO FEBRUARY, 1917.[1]

By C. DORNO.

[Davos Observatory, Davos, Switzerland, July, 1917.]

Systematic observations on the polarization of skylight, twilight phenomena, and on Bishop's Ring have been carried on at the Davos Observatory from the Fall of 1911 to February, 1917, in addition to continued pyrheliometric measurements and determinations of solar and sky radiation in many portions of the spectrum.[2] These all agree in showing: The great Katmai disturbance which, in June, 1912, brought to a close a period of exceptionally great purity of our atmosphere, very gradually came to an end toward the close of the year 1914. Even at the beginning of 1915 the atmosphere had not wholly recovered the degree of purity which characterized 1911. In the course of 1915 rapidly disappearing individual disturbances could be recognized; they rapidly increased during the first half of 1916, and in the second half of 1916 led to a new, uninterrupted period of disturbance having a milder character than that of 1912.

In the years 1915 and 1916 Bishop's Ring did not always present the appearance of a silvery white "inner disk" surrounded by a less brilliant bluish-white "outer

[1] Translated for the MONTHLY WEATHER REVIEW from the separate: Atmosphärisch-optische Störungen (Herbst 1911 bis Februar 1917), von *C. Dorno*. Astronom. Nachr., Nr. 4899, August, 1917, Band 205.—C. A., jr.

[2] There are in course of publication in the Abhandlungen d. Kgl. preuss. Meteorol. Instituts, detailed studies of twilight observations and ring phenomena, accompanied by a large amount of tabulated material. More complete extracts from these studies appeared in the April-Mai and the Juni-Juli issues of the Meteorologische Zeitschrift for 1917. There are still in preparation the chapters on "Himmelshelligkeit und Himmelspolarisation" and "Sonnenstrahlung."

disk" whose periphery was reddish white. On the contrary, the phenomenon consisted of a system of rings of manifold colors and brilliancies, its maximum radii corresponding to those of the Bishop's Rings of 1912–1914 and 1885–1887, while nearer the sun there reappeared a brighter blue "intermediate disk," a blue-white [wreath] ("Kranz") and a yellow to whitish "corona." The variations in the visibility of these divisions, of their intensities as to definition and brightness, of the radial magnitudes of the different rings as depending on the one hand upon the sun's altitude and on the other upon atmospheric conditions—the systematic observations of which at Davos was stimulated by J. Maurer's publications [3]—when all taken in connection with the march of the relative sun-spot numbers and of the intensity of solar radiation and in the light of the evidence and theoretical considerations detailed elsewhere, lead to the following briefly stated conclusions:

The plain Bishop's Ring consisting of simply an inner and an outer disk, as seen in 1885–1887 and 1912–1914, arises through the diffraction due to the presence of a very large number of particles of very different sizes, some of which float at greater altitudes but chiefly are found filling all the intermediate and lower levels of the troposphere. The light-scattering effect of these numerous and multi-form particles increases the brilliance of the inner disk and interferes with the perception of the more delicate differences in brightness close to the sun, in so far as such differences exist at all. If such a ring endures without interruption for a long time and with scarcely varying intensity, then its terrestrial origin is very probable. The magnitude of the smallest diffracting particle may be computed by Pernter's theory; the average for those accompanying the Katmai disturbance, which began in 1912 and gradually died out toward the end of 1914, was found to be a diameter of 0.00089 mm. as against one of 0.00152 mm. for those of the Krakatao disturbance of 1885–1887.

Diffusion plays scarcely any rôle in the differentiated optical phenomena of the year 1915–16. These were due to diffraction phenomena caused by quite exceptionally small particles of very slightly varying size and—as the limits of the different brilliancies indicate—restricted kinds or forms, which probably without exception floated at greater altitudes (15 to 20 km.) and consisted chiefly if not altogether of ice crystals. Essentially, therefore, they are probably identical with the frequently observed super-cirri (Übercirren). The size of the smallest particles is computed to be 0.00075 mm, while preliminary computations indicate that the size of the largest may be estimated as 10 to 40 times as great—i. e., they are of the size of the cloud-forming elements. The regularity of the ratios obtaining between the radii of the different rings invites speculation concerning the number, forms, and relative sizes of the particles. There appear to be no grounds for the assumption that the small rings arise in lower atmospheric strata than do the large ones. The increase of the radii with decreasing solar altitudes takes place more rapidly for the small radii than for the larger ones, and is due to the increasing intensity of the diffracted rays with simultaneous decrease in the intensity of the direct rays, to the increasing percentage of long waves in the rays and the stronger diffusion by the portion of the atmosphere nearer the horizon.

The diffracting ice crystals are regarded as being formed through the agency of condensation-nuclei thrown out by the sun; terrestrial volcanic activity probably had but a subordinate part in the disturbances of the years 1915 and 1916. In support of this view are pointed out—

(1) The frequency and spasmodic character of the appearance and disappearance of the phenomena;

(2) That during the time of the completely disconnected individual disturbances up to July, 1916, almost without exception there was a synchronism between the beginnings of more pronounced solar activity of the ring phenomena and of decrease in insolation (Strahlungsverlust); and that after the disturbance had assumed a continuous character in the second half of 1916, plainly recognizable intensifications were repeatedly found to synchronize with the beginning of a more pronounced solar activity.

(3) The persistently similar character of the decay of the individual disturbances, viz, first the disappearance of the great disk, the longer duration of the small ones, not rarely the sudden replacing of the great disk by a small one—i. e., the small nuclei of condensation evaporating sooner than the large ones.

Condensation-nuclei of solar origin are regarded as including all that may be regarded as exciting the auroræ. Comparisons of variations in intensity at numerous and quite widely distributed points on the earth's surface could give some idea of the path of the incident particles through the earth's atmosphere.

The connection between intensity of solar activity and the occurrence or strengthening of the "telluric solar corona" [4] was a regular and intimate one at Davos during the period of observation. Only a long period of observations conducted simultaneously at widely separated mountain observing stations can determine whether or no this connection always exists. The variation in the degree of purity of the atmosphere, caused by such a possible continual connection, would exert, on the incoming and outgoing radiation and the general circulation of the atmosphere, an influence not to be disregarded as a meteorological factor. At present one is not inclined to ascribe a high value to the magnitude of such an influence, for according to existing observations the incident radiation is weakened for but a short time just at the beginnings of the disturbances and of the stronger development of the outer and the inner disks, and it recovers rapidly as soon as the differentiated small rings becomes recognizable. It will, however, be necessary to devote all our attention to the further development of the phenomena under the influence of further increasing solar activity.

Variations in the solar constant can be determined with certainty only when one takes into account the apparently frequent local and temporal variations in terrestrial atmospheric transparency (purity) at a number of localities and if possible at the antipodes.

Meteorological influences introduce an annual period in the ring phenomena, in so far as such influences affect the visibility and definition. An annual period conditioned by the dust masses located in the ecliptic seems to be not wholly out of the question. In any case the heaping of disturbances in April, June, and August, as observed in the past, should be kept in mind in future work.

[3] Maurer, J. *in* Astronomische Nachrichten, Nos. 4813 (201:247), 4854 (203:99), and 4875 (204:45); also elsewhere.

[4] This term was proposed by J. Maurer to include all the ring phenomena, and the author here indorses the proposal.—*C. Dorno.*

TRANSPARENCY OF THE ATMOSPHERE FOR ULTRA-VIOLET RADIATION.

By R. J. STRUTT.

[Dated: Imperial College of Science and Technology, South Kensington, London, Oct. 22, 1917. *Reprinted from* Nature, London, Oct. 25, 1917, **100:** 144.]

It is well known that the solar spectrum, even when observed from a mountain top so that there are fewer than 4 miles of "homogeneous atmosphere" overhead, does not extend so far as $\lambda = 2{,}900$, however long an exposure is given. It has further been long suspected that absorption by ozone is the cause, as originally suggested by Hartley. Perhaps it may be claimed that the recent work of Prof. A. Fowler and myself [1] leaves little or no room for doubt that this is the true explanation.

As a sequel to the work just mentioned, I have photographed the spectrum of a mercury-vapor lamp 4 miles distant, and found that it extends as far as the line $\lambda = 2{,}536$, and perhaps farther. This line lies near the maximum intensity of the ozone absorption band, and therefore ozone can have nothing to do with the limit of the spectrum in this case. To reconcile the two results it is necessary to assume that there is much less ozone near the earth's surface than at high levels, a conclusion in agreement with the published chemical determinations of atmospheric ozone by Hayhurst and Pring.

The distant mercury-lamp spectrum showed a considerable falling off of intensity in the region of short wave lengths, long exposures being required to bring out $\lambda = 2{,}536$, which is one of the brightest lines when atmospheric absorption does not intervene. Such a result is to be expected according to known data on atmospheric scattering of light, apart from the action of ozone.

In this connection I may mention that I have succeeded in observing the scattering of light by pure dust-free air in a laboratory experiment with artificial illumination. Details of these investigations will be published later.

[1] Proc., Royal Society, Sect. A, 1917, **93:** 577; *Abstract*, this REVIEW, Sept., 1917, **45**: 443.

A. BRESTER'S THEORY OF THE SUN.

[*Reprinted from* Nature, London, Oct. 25, 1917, **100:** 154.]

In anticipation of a further volume on the constitution of the sun, Dr. A. Brester has issued the introduction and general conclusions in pamphlet form (La Haye. P. van Stockum et fils, 1917). As is well known, Dr. Brester does not accept the general view that the surface of the sun is subject to violent disturbances, and seeks to explain solar phenomena on the basis of a relatively tranquil gaseous globe which is practically undisturbed by convection currents. The solar gases decrease in density and luminosity from the center outward, but on account of their opacity their light never reaches us. The photosphere is a condensation stratum which is rendered luminous in the same way as a mantle in an ordinary gas flame, while a sunspot is a perforation through which the less luminous surface layer of the interior gases becomes visible. The varying frequency of spots is accounted for by supposing that at minimum the heat of the central nucleus is prevented from escaping by a photosphere of relatively great thickness, and that afterward, owing to contraction, the temperature of the nucleus increases to such an extent that the photosphere becomes attenuated and subject to perforations in the form of spots and pores. Radiation from the nucleus is then facilitated, so that the photosphere again increases in depth, and eventually produces another minimum. The chromosphere, prominences, and corona are regarded by Dr. Brester as effects of a permanent aurora which is maintained by electrons projected from the photosphere.

It is generally believed by astronomers and other students of astrophysical phenomena that the modern spectrograms of the sun's photosphere, and particularly the successive spectrograms for some particular and suitable line (e. g. H_α of hydrogen), demonstrate beyond question that the incandescent gases are there in pronounced motion and sometimes in very violent motion. The motions revealed by the displacement of spectroscopic lines and by comparisons of successive spectrograms, may be classed as (1) those of the general circulation of the sun about its own axis, motions which vary with both latitude and depth just as do those of the earth's atmosphere; (2) those of "local" disturbances, some of which appear as the familiar spots, motions of a vortical character, and adjacent disturbances often show related opposite whirls suggesting that they are often but opposite ends of one and the same vortex.

It is believed that the nucleus is constantly much hotter than the gases of the photosphere; because a relatively hotter photosphere would not absorb radiation in a manner to produce the dark-line spectrum actually produced by the reversing layer. This would not permit, apparently, of a nucleus relatively cooler than the photosphere (which would wipe out the dark-line spectrum), and thus seems to argue against Brester's explanation of the variation in frequency of sunspots.

C. G. Abbot's book "The Sun" (New York, 1911) is the most convenient reference work for those interested in this question. Recent notes on solar conditions will also be found in the MONTHLY WEATHER REVIEW, 1914, **42:** 168; 1915, **43:** 501–502; 1916, **44:** 113, 508.—C. A., jr.

LUNAR RAINBOW.[2]

Mr. Edward L. Wells, Meteorologist, Boise, Idaho, contributes the following notes on a lunar rainbow observed in Idaho.

A lunar rainbow was observed at Porthill, Idaho, on September 26, 1917, by Mr. H. A. French, cooperative observer. It was thought at first that an aurora had been mistaken for a rainbow, but correspondence with the observer has identified the phenomenon as a rainbow, without question.

Mr. French states that the bow was complete and quite bright, appearing at 8:50 p. m. Pacific time, and lasting about 10 minutes. The moon was slightly past the meridian and was shining with unusual brilliance, while the northern sky was cloudy and dark, with a heavy shower occurring at some distance in that direction.

Porthill is on the international boundary line between Idaho and British Columbia, in Lat. 49° 0′ N., and Long. 116° 35′ W. There are moderately high mountains toward the east and west, but the broad valley of the Kootenai River extends northward to Kootenai Lake, giving a rather low horizon toward the north.

Mr. French is a very capable and careful observer.

[2] Prepared and published by Division of Aerological Investigations.

HALOS OF OCTOBER 3, 1917, IN TEXAS AND OHIO.[1]

Houston, Texas—The following notes and sketch (fig. 1) of a solar halo observed at Houston, Tex., on October 3, 1917, are furnished by Mr. B. Bunnemeyer, Meteorologist. Of special interest are the oblique arcs of the anthelion marked "*g*", which are shown to meet in the upper part of the 22°-halo.

A perfect solar halo was observed at Houston, Tex., at 11:30 a. m., October 3, 1917, consisting of (*a*) a halo of 22° radius; (*b*) an elliptical circumscribed halo; (*c*) arcs of a halo of 45°; (*d*) supralateral arc tangent to halo of 45°; (*e*) infralateral arcs tangent to halo of 45°; (*f*) parhelic circle of approximately 35° radius with zenith as center; and (*g*) oblique arcs of the anthelion *touching the halo of 22°*. The halo was at its best when first observed. The accompanying sketch (fig. 1) of the phenomenon was prepared by Mr. I. R. Tannehill, assistant observer.[2]

There were no parhelia. The parhelic circle (*f*) and the oblique arcs of the anthelion (*g*) were white; all other circles or arcs of circles exhibited the colors of the rainbow, with the red color toward the sun. The display was indescribably beautiful and caused general comment and numerous inquiries as to its significance. The day was perfect, with an average cloudiness of only 3/10. Cirrus and cirro-stratus clouds surrounded the sun, intermingled with a very few cirro-cumulus. Here and there a few small cumulus clouds drifted across the sky. A faint cirrus haze was also observed. The parhelic circle and oblique arcs of the anthelion seemed to be projected for a large part upon a clear sky. The northern portion of the circumference of the halo of 22° and of the elliptical circumscribed halo were superimposed for a distance of about 40° and the southern for a distance of perhaps 12°.

The phenomenon began to dissolve slowly toward noon and by 2:30 p. m. the last traces had faded away. For twelve days preceding its appearance and for four days following it, the weather was perfect with mostly clear sky.

The time used was that of the 90th meridian.

Gallia, Ohio.—Solar halo phenomena were also observed on this date by Mr. J. S. Houser, Associate Entomologist of the Ohio Agricultural Experiment Station. His description and sketch (fig. 2) follow:

I am inclosing a sketch of parhelia redrawn from a field sketch made at Gallia, Ohio, October 3, 1917, at 2:30 in the afternoon.

Perhaps such phenomena are quite common to you but it was decidedly unusual to me. The semicircular bands of light *A* and *B*, while indistinct, were continuous, and the intensified patches of light *C*, *D*, *E*, *F*, *G*, *H*, *I*, and *J*, appeared with varying degrees of distinctness. Patch *C* was the most distinct of all, but was scarcely more distinct than the X-shaped area *J*. The figure as shown represents the phenomenon in its most glorious stage. It was, of course, constantly changing.

My observations and the field sketch were checked and verified by Dr. Tipton, of Gallia.

[1] Prepared and published by Division of Aerological Investigations.
[2] Additional inquiry of the Houston office force confirms the correctness of this point in the sketch here published as fig. 1.—C. A. jr.

DEVICE FOR OBSERVING RADIANTS OF AURORAS.

Late in November 1917 the editor received a request from a prominent American physicist for "observations of the aurora relative to focus [apparent focusing of the rays]." In spite of the large number of reports of the great aurora of August 26, 1916, published *in full* in the MONTHLY WEATHER REVIEW for that month, it was not possible to refer to many observations of really useful precision. Many of our observers and readers surely desire to improve the quality of their observations and will welcome the following suggestions put out by the Meteorological Office in London.[1]

Observers of auroras who wish to determine the bearing and elevation of the radiant of the streamers may find the following description of the device adopted at Eskdalemuir of service: A fan of strings is fixed in a window. On the window sill is placed a stand which carries a card in which a large peephole has been punched. The card is moved up and down and to and fro until the strings and the streamers appear to radiate from a common point. It may be assumed that the streamers are parallel lines which only appear to meet on account of perspective. The line joining the peephole to the point where the strings meet must be in the same direction.

Attempts to connect the stray electric waves which are so frequently noticed in wireless telegraphy, with auroras have not met with success hitherto, but the information concerning auroras available in this country [England] has been somewhat meager. To make it more systematic observers are invited to send in reports giving—

(1) Position of radiant [determined perhaps as above].
(2) Angular dimensions and positions of arches.
(3) Some indication of intensity.

[1] *Great Britain.* Meteorological Office circular, No. 8, January 29, 1917, page 3, "Notes and Queries."

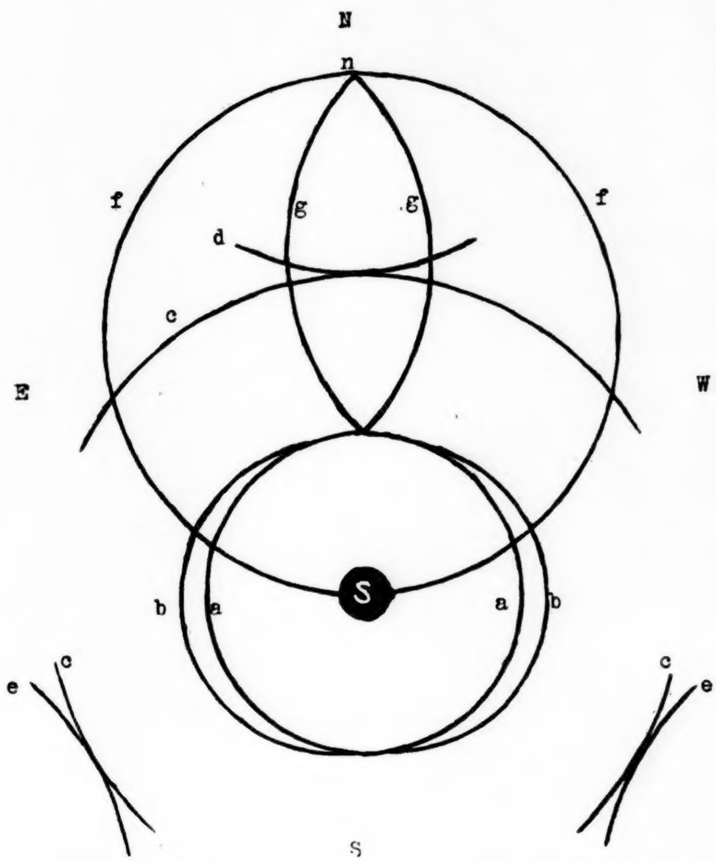

FIG. 1.—Halo phenomena observed at Houston, Tex., Oct. 3, 1917, at 11:30 a. m. Note the intersection of the oblique arcs of the anthelion (g, g) at the upper summit of the 22° halo (a). (90th meridian time.) (I. R. Tannehill, *delin.*)

FIG. 2.—Sketch of halo phenomena observed at Gallia, Ohio, Oct. 3, 1917, at 2:30 p. m. (J. S. Houser, *delin.*)

SECTION II.—GENERAL METEOROLOGY.

NOTES ON THE CLIMATE OF FRANCE AND BELGIUM.

By PRESTON C. DAY, Climatologist and Chief of Division.

[Climatological Division, Weather Bureau, November 12, 1917.]

Introduction.

The present interest of the people of the United States in matters pertaining to Europe has extended to questions of climate and the probable effect of the weather upon the health and comfort of those who have been or who may be called for service in France and Belgium. Numerous inquiries relating to weather conditions usually experienced in those countries have been received, and it seems proper to present to the public at this time a description of their more important climatic features. As there is generally shown on the part of the inquirer a desire for comparisons between weather here and there, sufficient data have been included to permit of such comparisons being made.

Geographical position.—France and Belgium together occupy that portion of the western coast of Europe extending from north latitude 42° 20′ to 51° 20′, which corresponds nearly to the portion of the American coast lying between Boston and the northern end of Newfoundland. In longitude they extend from 4° 42′ west of Greenwich to 7° 30′ east. Their outlines and some of the more important topographic features, including river systems, and locations of various towns are shown on figure 1.

The geographical location of France and Belgium with respect to latitude and their areas as compared with the United States are shown on figure 2, where their outlines are superposed on a chart of the United States and portions of Canada. By referring to this chart it will be seen that in latitude these countries lie largely to the north of the United States. Marseille, the most southerly important city of France, is seen to be farther north than Boston, while Paris is nearly 500 miles farther north than Chicago. Brussels, in latitude 50° 51′, is more than 50 miles farther north than Winnipeg, Canada, or in the same latitude as the southern portion of Hudson Bay. The difference in longitude is such that local time at Paris is approximately five hours later than at New York, that is, when it is noon at New York it is

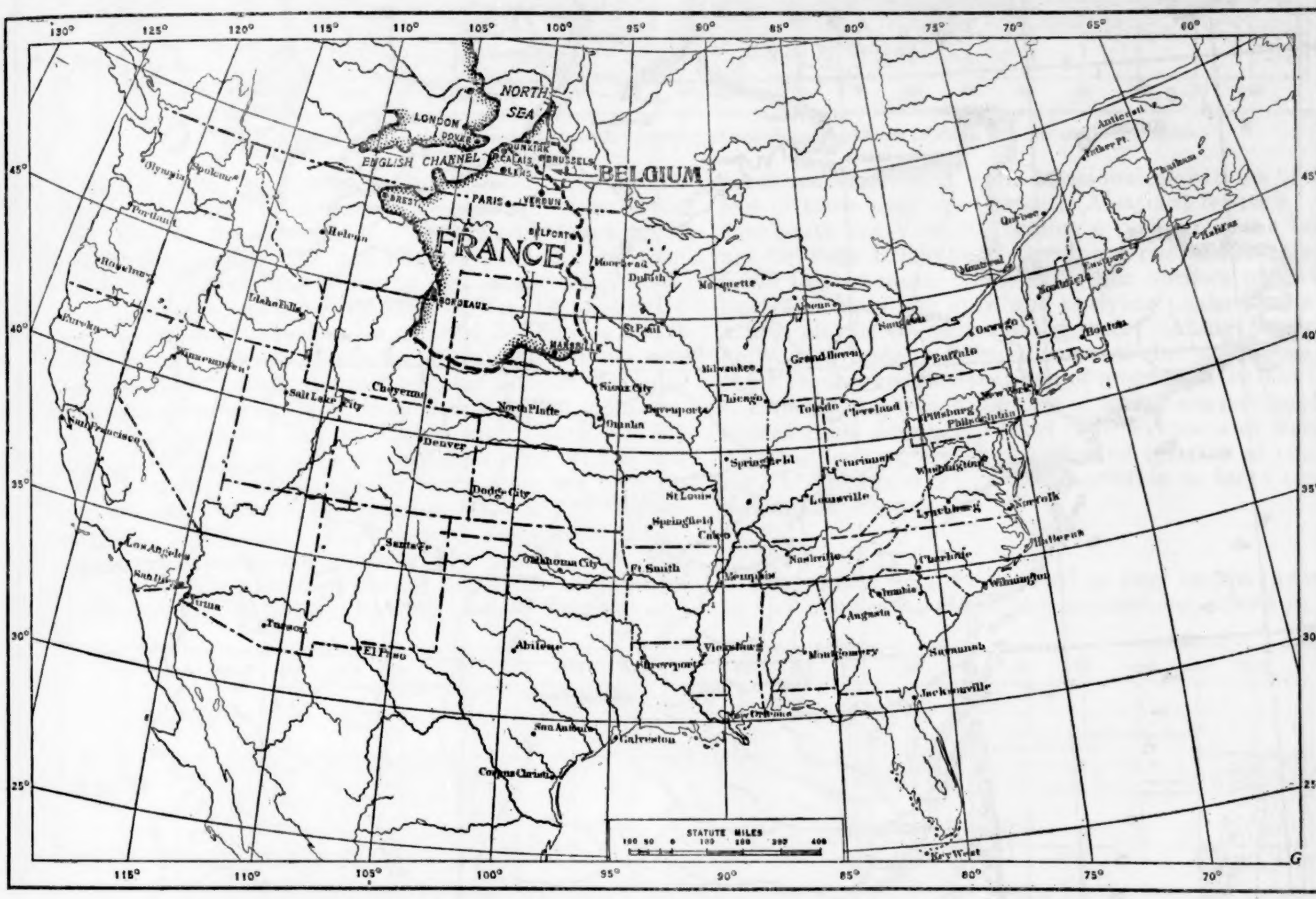

FIG. 2.—Map comparing the relative areas and geographic latitudes of France-Belgium and the United States of North America.

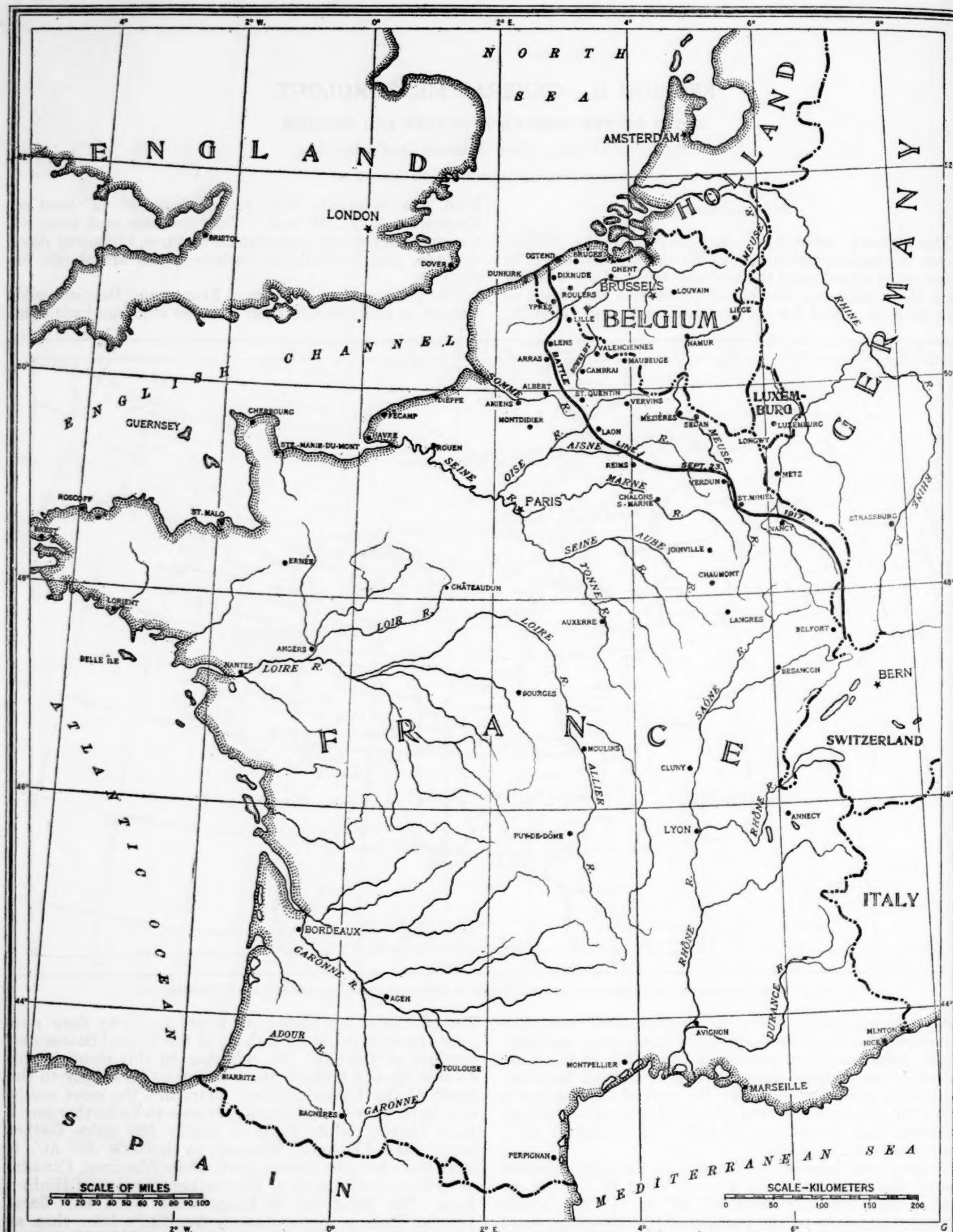

FIG. 1.—Map of France and Belgium, showing rivers, localities referred to in accompanying tables, and approximate battle line on September 23, 1917.

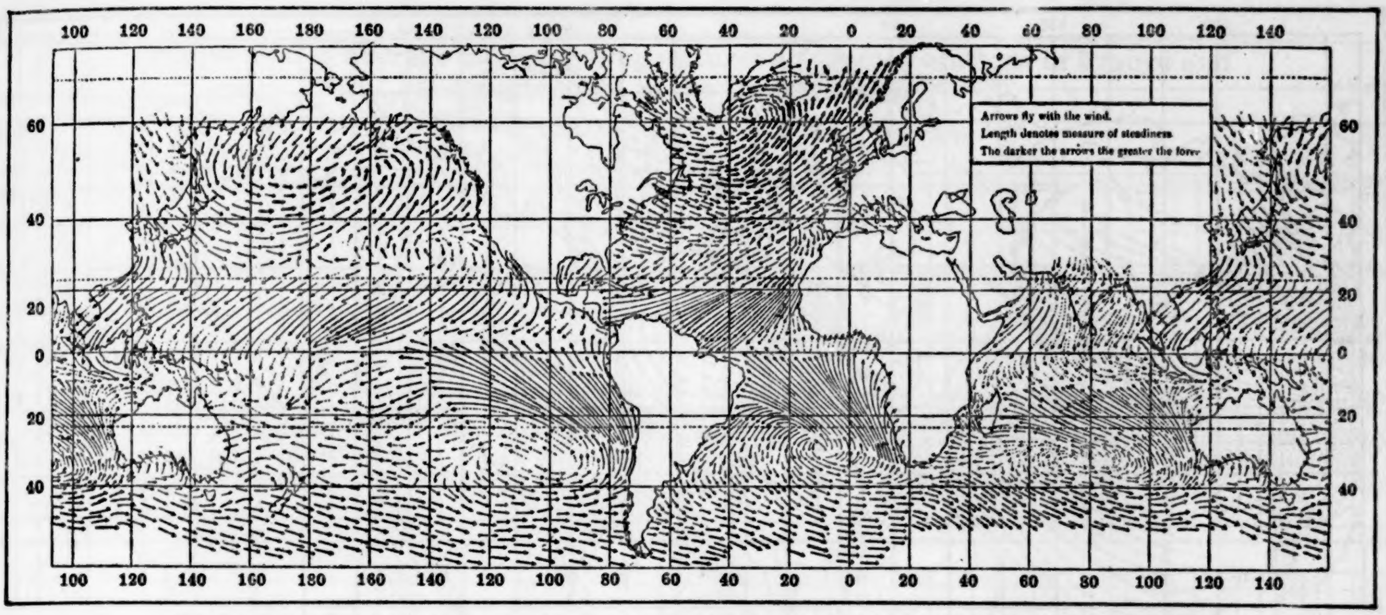

FIG. 3.—Chart of ocean winds in January and February, showing normal directions, relative velocities, and constancies. (Koeppen.)

already 5 p. m. at Paris; six hours later than at St. Louis; seven hours later than at Denver, and eight hours later than at San Francisco. Thus during the longer days of the year as the sun is setting on our western coast it is rising on the following day in eastern France.

Area and topography.—The area of France is slightly less than 210,000 square miles, that of Belgium is about 11,000 square miles, and the combined area of the two countries about equals that of the States along our Atlantic seaboard from North Carolina to New England, inclusive.

The northwestern half of France and practically the whole of Belgium consists principally of low plains and shallow, open valleys, gradually rising from sea level on the west coast toward the interior, with few elevations exceeding 1,000 feet. The eastern and southeastern portions of France are considerably broken, the land rising in the north portion toward the Ardennes, a series of hills and low mountains in southeastern Belgium and northeastern France, with occasional elevations of 2,000 feet or more near the German (Alsatian) frontier. Farther south the Vosges, forming a portion of the boundary between France and Germany, rise to elevations of 5,000 feet or more, while along the borders of Switzerland and Italy the Jura and outlying peaks of the Alps attain elevations somewhat greater. Along the border between France and Spain some of the higher peaks of the Pyrenees reach elevations of more than 10,000 feet.

Important rivers, a number of which are navigable for considerable distances, drain both France and Belgium, which, together with the extensive systems of connecting canals, afford water transportation to large areas of the inland region.

Climate.

France and Belgium, located as they are, in the region of the eastward drift of the atmosphere, afford in their

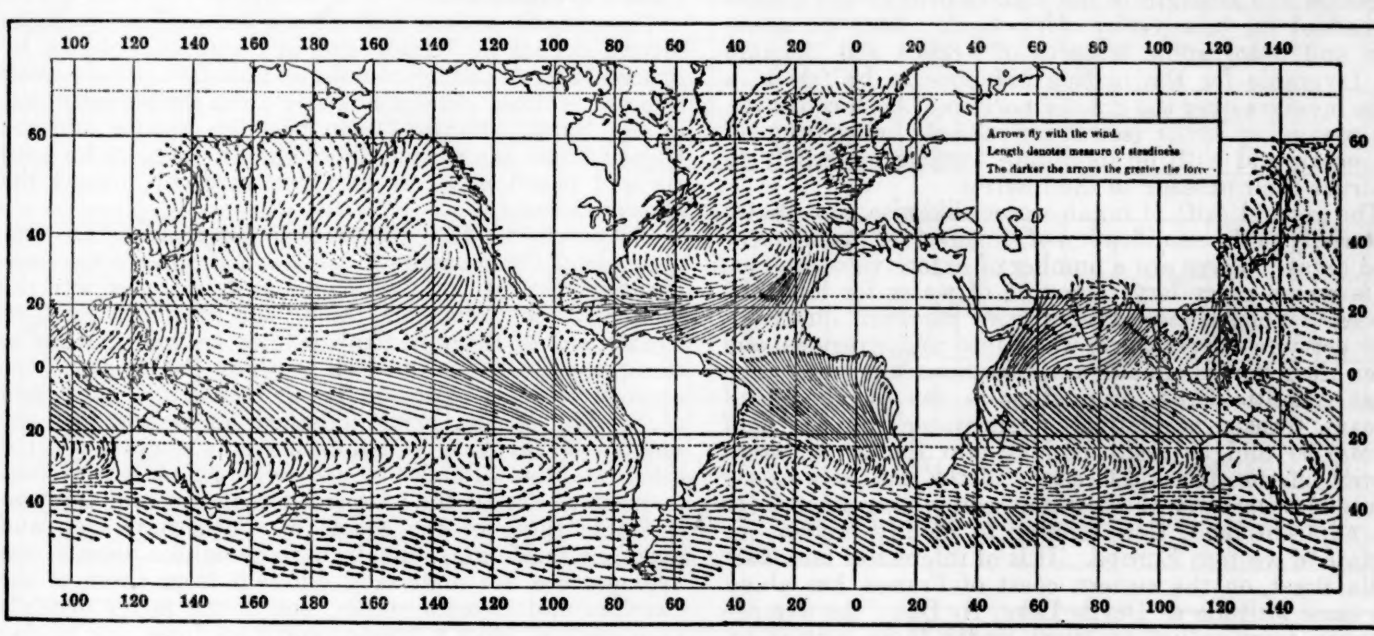

FIG. 4.—Chart of ocean winds in July and August, showing normal directions, relative velocities, and constancies. (Koeppen.)

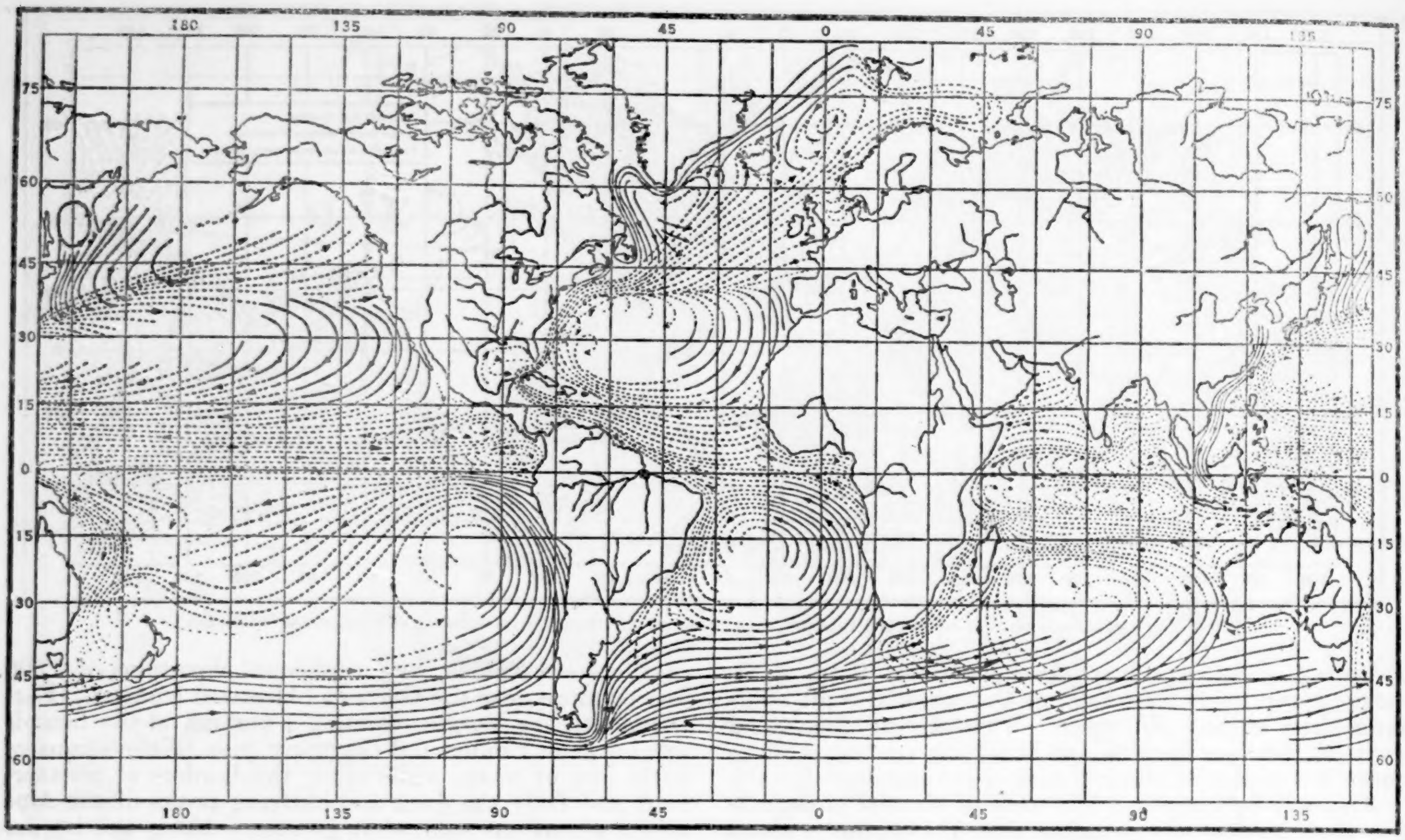

Fig. 5.—Chart of average annual ocean currents. Warm currents indicated by dotted arrows; cooler currents by continuous arrows.

climate an excellent example of the modifying influences exerted upon land areas by the proximity of large bodies of water to their western borders. Water surfaces warm slowly under the direct rays of the sun and also cool slowly in the absence of direct solar radiation, resulting in a comparatively uniform temperature condition. This marine influence is felt in varying degrees over land surfaces adjacent to large bodies of water, its potency and distance reached inland depending on the direction and strength of the surface drift of the atmosphere and the topography of the land. Both the situation and topographic features of France and Belgium are favorable for the marine influence to be felt in a large measure over the greater portion of both countries, the prevailing winds (see figs. 3 and 4) being from off the ocean and with no mountain barriers materially to obstruct their passage to the interior.

The general drift of ocean waters likewise contributes materially to the modification of climate over the adjacent land areas. There are a number of extensive ocean currents which carry large amounts of water for long distances. When these currents have poleward directions they carry relatively warm water into colder regions, and when their flow is equatorward the reverse is true. The great Atlantic Drift, originating in the so-called Gulf Stream, transports relatively warm water from the Gulf of Mexico and adjacent regions into the northeastern portion of the Atlantic Ocean, and the normal westerly winds blowing over these waters carry their warmth to the adjacent land, thus tending to modify further the climate of western Europe. It is of interest to note that while Brest, on the western coast of France, has about the same latitude as Devils Lake, N. Dak., the average January temperature at Brest under these marine influences is 44° F., while at Devils Lake (under continental influences) it is about 0° F. Greater variations are shown in the extremes, where for the vicinity of Brest the lowest observed winter temperature probably does not reach 0° F., while readings of nearly 60 degrees below 0° F. have been observed in the vicinity of Devils Lake. On the other hand, owing to the less rapid cooling of the ocean waters as compared with the land, the ocean winds of summer are cooler than those from the land, and in July the average temperature of Brest is only 64° F., while at Devils Lake it is about 68°.

The general surface drift of the atmosphere over the several oceans in Winter and in Summer is shown by figures 3 and 4, and figure 5 shows broadly the movement of ocean waters. It will be noted from these charts that in the North Atlantic Ocean between Europe and the United States the normal direction of movement for both air and ocean water is northeastward, or toward the European coast.

Temperature.—The outstanding features of the temperature of the countries of western Europe are the comparatively warm winters for such high latitudes, and the relatively cool summers. Along the coasts of northern France and of Belgium temperatures are very similar to those experienced on our own northern Pacific coast, the average monthly temperatures at Dunkirk, France, and at Seattle, Wash., being identical for nearly half the months of the year and differing only slightly for the other months. Farther south over the Atlantic coast districts of France the temperatures throughout the year resemble those of the coasts of southern Oregon and northern California, and during the winter months the averages are not materially different from those of the Carolina and Georgia coasts, but in the latter districts temperatures have a greater variation from day to day and the extremes are decidedly more pronounced. The

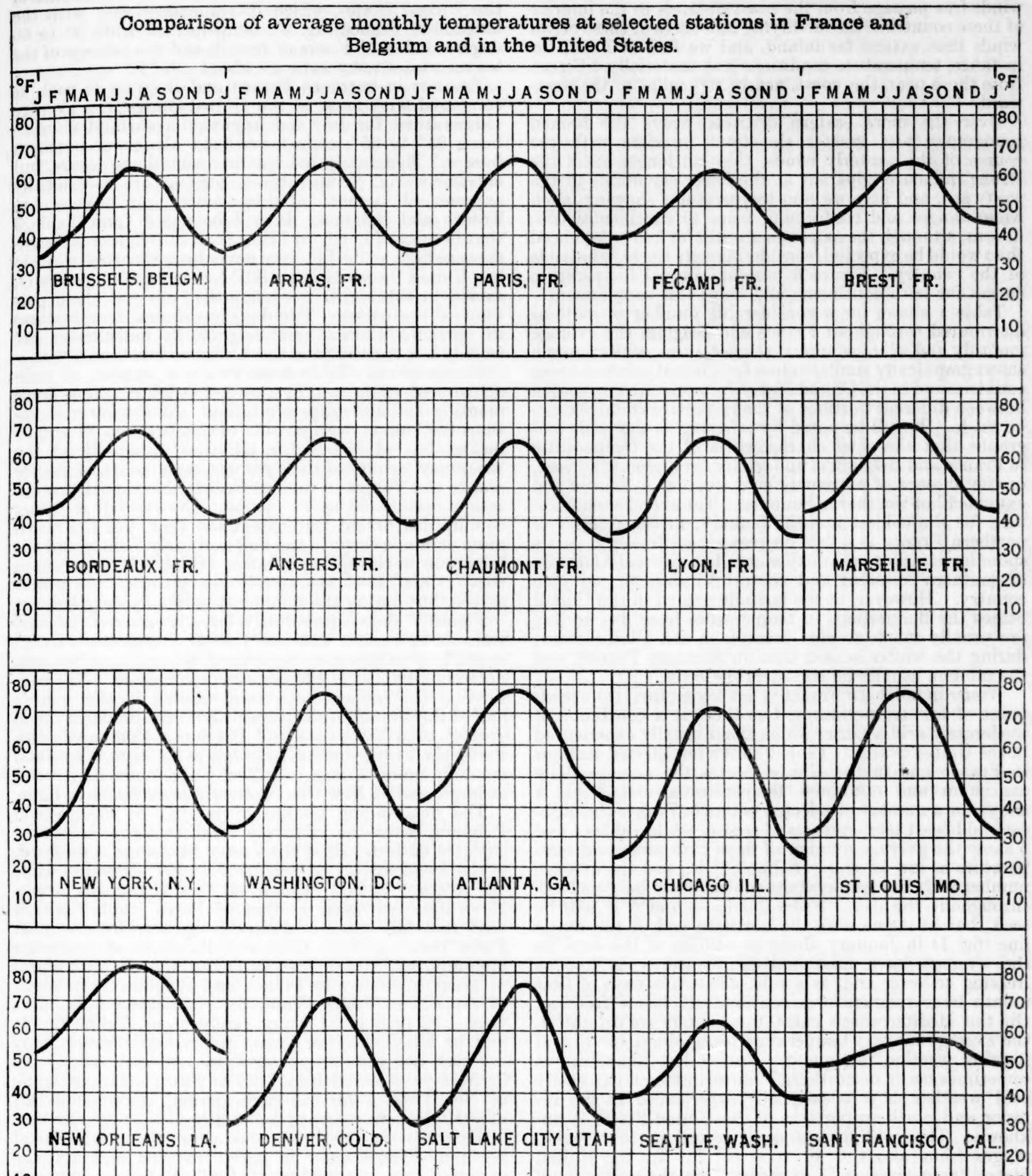

FIG. 6.—Synoptic chart of annual temperature marches at selected stations in France, Belgium, and the United States.

absence of mountain barriers affords the prevailing ocean winds free passage from the coast districts to the interior of these countries; the modifying influences of these ocean winds thus extend far inland, and we find at Paris, for instance, temperature conditions not materially different from those near the coast, nearly 200 miles to the westward.[1]

Over the more eastern districts, where the broken topography and greater elevations interfere with the course of the westerly winds, they no longer exert the strong influence apparent at the lower elevations to the westward, and here we find temperatures showing much wider ranges and conforming more to continental conditions, although the extremes are still far less pronounced than would be expected, considering only the high latitude of the country. Figure 6 presents annual temperature curves for both continents and helps this comparison.

Table 1 shows for a considerable number of stations distributed throughout France and Belgium the average monthly and average annual temperatures, while figure 6 shows graphically similar values for selected points in those countries and in the United States, from which comparisons between different portions of the respective countries can be made. It will be noted by referring to the table and graphs that the chief characteristic of the temperature in France and Belgium is uniformity throughout the year, or the absence of extremely cold weather in Winter and extended hot weather in Summer. The average temperature for the coldest month, January, in the interior of northern France is a few degrees above freezing, corresponding closely to that experienced at about the latitude of southern Missouri and central Virginia in our own country. However, at the latitude named in the United States the fluctuations in temperature from day to day are usually much greater (except on the Pacific coast) during the winter season than in northern France, and the minima usually go considerably lower.

Winter in northern France is not severe from the standpoint of low temperatures, but there is a constancy of moderately cold weather which is not usually experienced in the United States. Table 2 shows for selected stations in France and in the United States the average daily maximum and minimum temperatures, and Table 3 shows for a number of selected points in France the highest and lowest temperatures of record, while Tables 4 and 5 show the average number of days with minimum temperature as low as or lower than 32° F., and the average number with the temperature continuously below 32° F. throughout the day. From Tables 4 and 5 it will be seen that at Arras near the northern end of the battle line (fig. 1) in January about two-thirds of the days on the average have minimum temperatures as low as freezing or lower and, as a rule, about five days of that month have temperatures continuously below freezing. On the Mediterranean coast the winters are delightful, the average January temperature being about 45° F. and freezing weather infrequent. Rather low temperatures sometimes occur in northern France, but such extremely cold weather as is occasionally experienced in the interior and northern portions of the United States is unknown. The coldest weather of record in that region ranges from about 0° F. to −10° F. In the United States "zero weather" has occurred on the central Gulf coast and −10° F. in the northern portions of the central Gulf States, while along the north-central border of the United States, which corresponds closely with the latitude of France (fig. 2), temperatures from 50 to 60 degrees below 0° F. are of record, and the average of the lowest winter temperature is about −35° F.

Summer in northern France and Belgium is cool, as compared with most of the United States, the average temperatures for July and August, the warmest months, being 63° to 65°, even lower than along our northern border. Moderately hot weather sometimes occurs, but extremely high temperatures, such as are occasionally experienced in much of this country, are unknown in France and Belgium. It will be noted from Table 3 that in most of northern France and in Belgium temperatures as high as 100° F. have never been reported, while in the United States 100° to 110° have occurred generally, except in the higher mountain districts and along portions of the coasts. The daily maximum temperatures in northern France and Belgium in midsummer are usually less than 80° and the minimum less than 60° F.

Precipitation.—Table 6 shows for a number of well-distributed stations in France and Belgium, the average monthly and annual precipitation. At the lower elevations the annual precipitation ranges between 20 and 30 inches, but at the higher altitudes, especially at the western extremity of the Pyrenees at the south of France and in the Vosges in eastern France the annual precipitation reaches 60 to 70 inches. The rainfall is rather equally distributed throughout the year, but the maximum amounts occur in the Fall and early Winter and the minimum in the spring months. On the Mediterranean coast rainfall is comparatively heavy during the winter season, but during the summer it is usually very light.

Figure 7 shows graphically for a number of selected stations in France and the United States the average monthly precipitation, permitting comparisons between different portions of the respective countries. Not considering the higher mountains, rainfall in the eastern half of the United States, especially in the South, is much greater than in France and Belgium. Compared with Paris, the average annual rainfall at Chicago is one and one-half times as large; at New York, more than twice as large, and at New Orleans nearly three times as large.

The outstanding feature of rainfall in France and Belgium, when the relatively small totals as compared with the eastern half of the United States are considered, is the frequency of its occurrence. For example, while the average annual rainfall at New Orleans is nearly three times as much as that of Paris, Table 7 shows that rain falls with considerably greater frequency at Paris than at New Orleans. Rainfalls of moderate amounts, 0.25 to 1.00 inch in 24 hours, occur with about as great frequency in France and Belgium as in much of the United States (Table 8), but heavier falls, more than 1.00 inch in 24 hours, rarely occur (Table 9). It will be noted that at Arras, in northern France, only one day had rainfall greater than 1.00 inch during the entire 5-year period from 1907 to 1911, inclusive, while at New Orleans for the same period, amounts of this magnitude were recorded on 63 days.

Snowfall.—In Belgium and over the lowlands of northern France snow is fairly frequent and may be expected from November to April, inclusive, although on account of the rather light character of the precipitation and the moderate temperatures, it rarely attains any considerable depth on the ground. At the higher

[1] A crude comparison between the severity of the winters at Paris and Washington D. C., was published in the MONTHLY WEATHER REVIEW, November, 1914, 42:626-9.—C. A., Jr.

elevations of eastern and southeastern France, particularly in the mountains bordering on Germany and Switzerland where the winters are long and cold, snowfall is more frequent and much heavier and in some places accumulates to considerable depths. At Brussels snow usually occurs on about 25 days during the year, in the vicinity of Paris snow may be expected on about 15 days, while along the English Channel it probably occurs, as a rule, on less than 10 days.

The average number of days with snowfall for each of the winter months and the year at a few selected points in Belgium and northern France, is shown in Table 12, and there compared with points in the United States.

Cloudiness.—The average cloudiness for each month of the year is given for selected stations in France and Belgium and in the United States in Table 11, from which comparisons as to this phase of the weather can be made. The amount of cloudy weather in France during the warm season of the year does not differ materially from that in much of our own country, but in Winter much more cloudy weather is experienced than in most of the United States, this being especially true in northern France and in Belgium. It will be noted from the records for Nice, Marseille, and Montpellier, that there is abundant sunshine in the Mediterranean coast districts at all seasons of the year.

SUMMARY.

From the standpoint of bodily comfort, the climate of northern France and Belgium may be briefly summarized as follows: The winter weather is rather rigorous and unpleasant, due to the persistence of comparatively low temperatures, much cloudiness and frequent rain and snow. The winds blow mostly from the west or southwest and are frequently damp and chilly, the relative humidity being rather high. The winter nights are long and the days correspondingly short. In the extreme northern portion of France, near the present battle line, the sun sets during the latter half of December a few minutes before 4 p. m., and rises about 8 a. m., making the nights, sunset to sunrise, about 16 hours long.

With the transition from Winter to Spring, the rapid warming up familiar to residents in most sections of the United States, is not so noticeable in France and Belgium, the average temperature for March being only 2 to 4 degrees (F.) higher than for February. April and May are moderately cool and not unpleasant, the length of the day increases much more rapidly than in most sections of the United States, and there is a correspondingly large increase in the amount of sunshine, while rainfall is comparatively light, although occurring rather frequently.

The summers are pleasant as compared with much of the United States, the day temperatures being mostly moderate and the nights cool. Occasionally hot weather is experienced, but the heat is not excessive and the periods are usually of short duration. During the latter part of June the days in northern France and Belgium are more than 16 hours long, the sun rising a little earlier than 4 a. m. and setting after 8 p. m.

Fall also is usually pleasant, especially during September and October, the temperature during these months being, as a rule, considerably higher than for the corresponding spring months. With the advent of fall the rainfall usually becomes heavier, resulting more from greater intensity of falls than from increased frequency. This usually is the season of maximum rainfall.

TABLE 1.—*Average monthly temperatures (°F.) for 39 localities in France and 4 in Belgium.*

[For locations see map, figure 1, p. [2].]

Station and dates.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Dunkirk (1881-1900)	39	40	42	47	52	58	63	63	60	52	44	40	50
Lille (1851-1900)	36	38	41	48	54	60	63	63	58	50	42	37	49
Arras (1876-1900)	35	37	41	48	54	60	63	63	57	49	41	36	49
Mézières (1883-1900)	35	37	41	49	55	62	65	64	58	50	41	36	49
Paris (1871-1900)	36	39	43	50	56	62	65	64	59	50	43	37	50
Rouen (1851-1900)	37	39	42	49	55	61	64	63	59	51	43	38	50
Dieppe (1873-1882)	37	39	41	47	51	57	60	61	57	50	43	39	49
Fécamp (1853-1882)	39	40	43	48	52	58	61	62	58	52	45	40	50
Ste. Marie-du-Mont (1871-1900)	40	41	43	48	53	58	62	62	58	52	46	41	50
Guernsey (1851-1900)	43	43	43	47	51	56	59	59	58	53	48	45	50
Saint Malo (1871-1900)	41	42	45	50	54	59	62	62	59	53	46	42	51
Roscoff (1891-1900)	45	45	46	50	54	58	61	62	59	55	49	46	52
Brest (1866-1900)	44	44	46	51	55	60	64	64	61	54	48	45	53
Ernée (1881-1895)	38	40	43	49	54	60	63	62	58	50	43	38	50
Lorient (1862-1900)	43	44	46	51	56	62	65	65	61	54	48	44	53
Belle Île (1886-1900)	43	43	45	50	55	60	63	64	61	55	49	45	53
Nantes (1856-1900)	40	42	45	51	56	62	66	65	60	53	45	41	52
Angers (1851-1900)	39	41	45	51	57	63	66	66	60	52	45	39	52
Châteaudun (1891-1900)	36	38	42	50	56	62	66	65	59	50	42	36	55
Auxerre (1886-1900)	36	39	43	51	56	64	67	66	60	51	43	36	10
Chaumont (1881-1900)	33	36	41	49	55	62	65	64	58	49	41	34	49
Langres (1891-1900)	32	35	39	48	54	61	64	63	57	48	39	32	48
Besançon (1891-1900)	33	37	42	50	56	63	66	65	60	50	41	34	50
Moulins (1881-1890)	36	38	43	51	57	63	67	66	60	51	42	36	51
Cluny (1881-1890)	35	38	43	51	56	63	67	66	60	51	43	36	51
Annecy (1876-1900)	31	35	41	50	57	64	67	66	60	50	40	32	49
Lyon (1851-1900)	35	39	44	52	58	64	68	67	61	52	42	35	51
Puy-de-Dôme (1881-1900)	28	29	30	35	41	48	52	52	48	40	34	29	39
Menton (1877-1886)	45	46	49	55	61	68	73	73	69	61	52	47	58
Nice (1884-1900)	44	45	48	53	59	66	72	71	66	58	50	45	56
Marseille (1851-1900)	43	45	49	55	61	68	72	71	65	58	50	44	57
Avignon (1872-1884)	39	44	49	56	63	70	75	73	66	57	47	40	57
Montpellier (1851-1900)	41	44	48	54	61	68	73	72	65	57	48	42	56
Perpignan (1851-1900)	44	46	50	56	61	68	73	72	66	58	51	45	58
Toulouse (1851-1900)	40	42	46	52	58	65	73	72	65	57	48	42	56
Agen (1881-1900)	40	42	46	53	58	65	69	69	64	55	46	40	54
Bagnères (1891-1900)	38	42	44	49	54	60	64	64	60	51	44	39	51
Biarritz (1886-1900)	46	48	50	54	59	64	69	69	65	59	51	47	57
Bordeaux (1851-1900)	41	43	47	53	58	64	68	68	64	55	47	41	54
Belgium:													
Ostend....(?)	36	38	42	47	53	59	63	63	60	51	44	39	50
Brussells (1851-1900)	34	36	40	47	53	60	63	62	58	50	41	36	48
Namur (1833-1862)	[a]35	[a]36	[a]40	[a]48	[a]56	[a]64	[a]66	[a]65	[a]57	[a]50	[a]40	[a]37	[a]50
Liége (1833-1862)	[a]35	[a]37	[a]41	[a]49	[a]57	[a]64	[a]67	[a]66	[a]59	[a]52	[a]41	[a]37	[a]50

[a] These averages are for 9 a. m. only.

AUTHORITIES:
For French stations: *Bigourdan*—Climat de la France. Paris, 1916.
For Belgian stations: Ostend from *Blanchard*—La Flandre. Paris, 1906.
Brussels from *Hann*—Handbuch der Klimatologie, 3d ed., v. 3. Stuttgart, 1911. p. 192.
Namur and Liége from *Quetelet*—Météorologie de la Belgique. Bruxelles, 1867.

TABLE 2.—*Average daily maximum and minimum temperatures at selected stations in France, Belgium, and the United States.*

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Fécamp, France (26 years):[1]	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
Maximum	43	46	49	55	60	66	69	69	66	58	49	45
Minimum	34	37	38	42	46	51	55	55	52	47	40	36
Sèvres, France, (near Paris, 10 years):[2]												
Maximum	40	44	50	61	66	73	77	75	70	58	49	42
Minimum	32	32	35	41	45	52	55	55	51	43	38	34
Marseille, France (49 years):[2]												
Maximum	52	55	59	65	71	78	83	82	77	68	59	53
Minimum	36	38	41	46	51	57	61	60	56	50	43	38
Brussels, Belgium (12 years):[3]												
Maximum	41	45	48	60	65	72	74	72	67	58	48	42
Minimum	33	36	37	42	48	55	58	58	53	46	38	34
New York, N. Y.:												
Maximum	37	38	45	57	68	77	82	80	74	63	51	41
Minimum	24	24	31	41	52	61	67	66	60	49	38	28
Atlanta, Ga.:												
Maximum	50	53	62	70	79	85	87	85	81	71	61	52
Minimum	35	37	44	51	60	67	70	69	64	53	44	36
Chicago, Ill.:												
Maximum	37	33	42	54	64	74	80	78	72	60	46	36
Minimum	17	18	28	39	49	59	65	65	58	46	33	23
New Orleans, La.:												
Maximum	62	64	71	76	83	88	89	89	86	78	69	63
Minimum	47	49	56	61	68	74	76	75	72	63	54	48
Denver, Colo.:												
Maximum	42	44	52	60	69	80	86	85	77	65	52	45
Minimum	17	20	27	35	44	52	58	57	48	37	26	20
San Francisco, Cal.:												
Maximum	55	58	60	62	63	65	65	65	68	67	62	56
Minimum	45	47	48	49	50	52	52	53	54	54	51	46

[1] From Annales du Bureau Central Météorologique de France, 1885.
[2] From Annales du Bureau Central Météorologique de France.
[3] From *Académie Royal de Belgique*, Observations des Phénoménes Périodiques, 1859-1870.

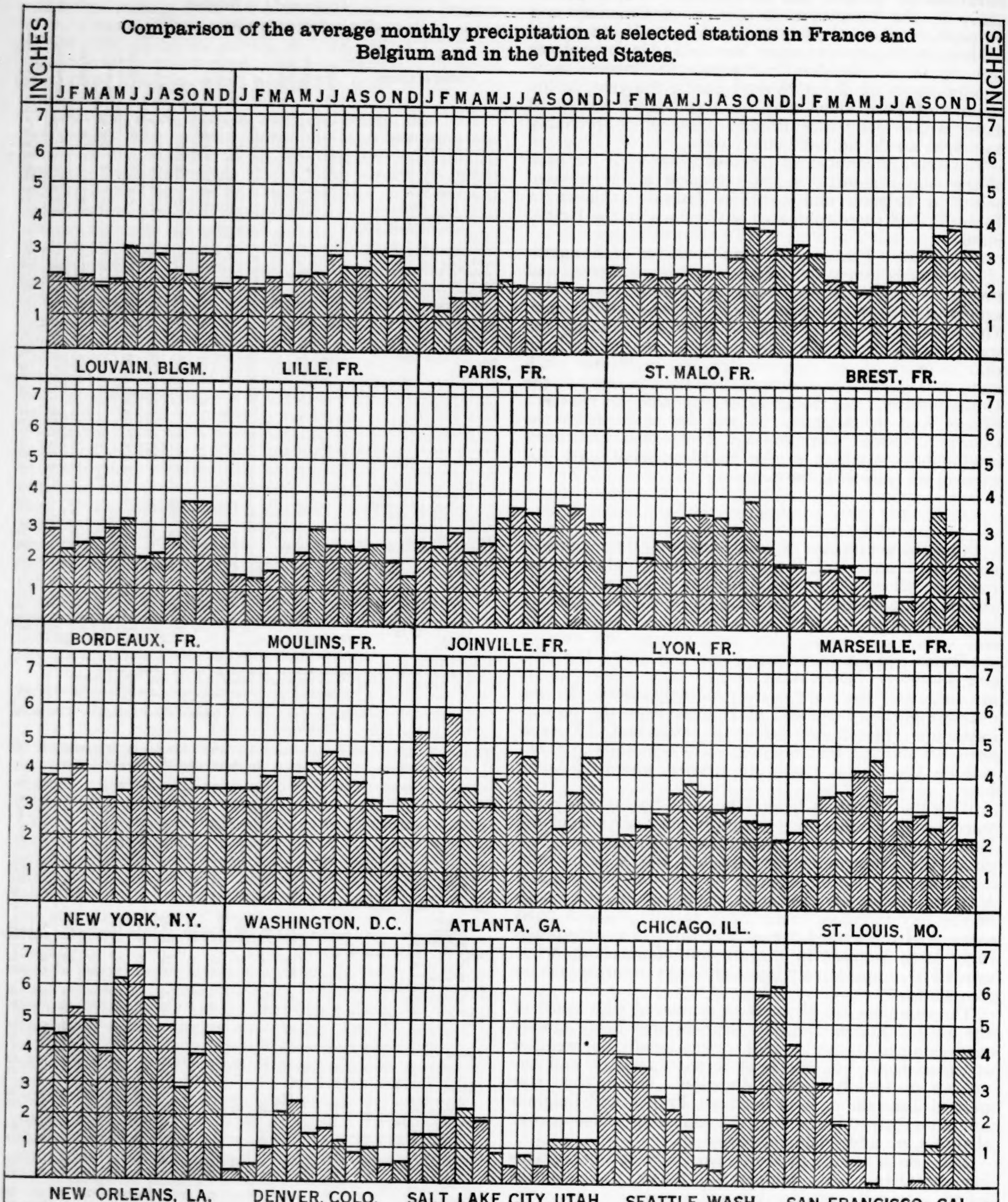

FIG. 7.—Synoptic chart of annual precipitation marches at selected stations in France, Belgium, and the United States.

TABLE 3.—*Highest and lowest temperatures ever recorded at selected stations in France.*

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Dunkirk (1881-1900):	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F	°F.	°F.	°F.	°F	°F.
Highest	56	65	71	75	87	88	89	97	91	77	70	59	97
Lowest	− 1	10	21	32	35	42	45	49	43	30	16	8	− 1
Lille (1851-1900):													
Highest	61	63	72	81	90	96	95	95	91	80	66	63	96
Lowest	0	5	18	27	32	37	39	45	37	22	16	− 2	− 2
Arras (1881-1900):													
Highest	56	64	72	79	91	95	99	96	92	80	68	60	99
Lowest	3	− 4	10	26	28	35	41	36	30	26	6	− 2	− 4
Paris (1851-1900):													
Highest	60	67	75	83	89	95	101	97	97	82	70	62	101
Lowest	7	7	16	26	32	38	43	43	35	26	7	−11	−11
Guernsey (1851-1900):													
Highest	57	59	66	76	77	81	85	87	83	73	66	60	87
Lowest	17	22	27	30	36	41	48	47	40	33	26	24	17
Nantes (1881-1900):													
Highest	64	64	71	83	86	94	102	99	98	83	71	62	102
Lowest	12	5	20	27	30	36	42	39	32	22	18	10	5
Chaumont (1876-1900):													
Highest	61	66	79	83	92	96	104	104	98	80	76	60	104
Lowest	−16	1	2	20	28	34	40	38	29	18	6	− 4	−16
Lyon (1851-1900):													
Highest	66	70	79	83	93	95	101	97	95	82	70	64	101
Lowest	−13	10	4	25	29	36	42	43	32	20	14	− 8	−13
Montpellier (1851-1900):													
Highest	69	77	82	86	94	102	106	102	98	86	76	70	106
Lowest	3	12	14	26	32	39	43	43	35	21	16	3	3
Bordeaux (1881-1900):													
Highest	67	72	78	84	91	96	103	107	98	86	75	67	107
Lowest	3	17	16	29	35	41	47	47	38	37	16	16	3
Brussels, Belgium, (1851-1900):													
Highest	56	65	70	78	91	94	95	95	88	77	68	60	95
Lowest	− 4	2	14	28	31	40	44	45	37	26	11	2	− 4

AUTHORITY: Annales du Bureau Central Météorologique de France, 1904.

TABLE 4.—*Average number of days with a minimum temperature of 32° F. or lower at selected stations in France and the United States.*

Stations.	October.	November.	December.	January.	February.	March.	April.	Annual.	Stations.	Annual.
FRANCE.	das.	das.	das.	das.	das.	das.	das.	das.	UNITED STATES.	das.
Dunkirk (1881-1900)	0	3	8	10	8	5	0	34	Boston, Mass	105
Arras (1881-1900)	3	8	15	18	16	12	4	76	Washington, D. C	89
Paris (1874-1900)	0	5	11	11	10	6	0	43	Cincinnati, Ohio	83
Fécamp (1871-1900)	0	4	8	10	7	4	1	34	Chicago, Ill	111
St. Marie - du - Mont (1870-1900)	1	4	11	11	8	7	2	44	Kansas City, Mo	97
Roscoff (1891-1900)	0	0	4	4	3	1	0	12	Minneapolis, Minn	148
Nantes (1881-1900)	2	5	11	12	12	8	2	52	Bismarck, N. Dak	182
Angers (1872-1900)	1	4	11	12	9	5	1	43	Denver, Colo	145
Langres (1889-1900)	2	9	20	20	17	12	4	84	Salt Lake City, Utah	106
Besançon (1885-1900)	3	9	20	22	18	13	3	88	Helena, Mont	149
Lyon (1881-1900)	1	6	17	20	15	10	2	71	Seattle, Wash	22
Nice (1885-1900)	0	0	3	5	4	2	0	14	San Francisco, Cal	0
Marseille (1867-1900)	0	2	8	9	5	3	0	27	Los Angeles, Cal	1
Montpellier (1881-1900)	0	2	12	14	10	5	0	43	Santa Fe, N. Mex	140
Perpignan (1881-1900)	0	1	5	8	4	2	0	20	San Antonio, Tex	12
Toulouse (1881-1900)	0	3	11	12	8	5	0	39	New Orleans, La	5
Bordeaux (1881-1900)	1	4	9	11	8	5	0	38	Atlanta, Ga	39

AUTHORITIES:
Annales du Bureau Central Météorologique de France, 1904.
U. S. Weather Bureau.—Climatological data for the States, 1895-1914.

TABLE 5.—*Average number of days with temperature continuously below freezing at selected stations in France and the United States.*

Stations.	Dec.	Jan.	Feb.	Annual.	Stations.	Annual.
FRANCE.	das.	das.	das.	das.	UNITED STATES.	das.
Dunkirk (1881-1900)	2	4	2	8	Boston, Mass	29
Arras (1881-1900)	4	5	2	11	Washington, D. C	15
Paris (1874-1900)	4	4	3	11	St. Louis, Mo	80
Roscoff (1891-1900)	0	0	1	1	Chicago, Ill	47
Nantes (1881-1900)	2	2	1	5	Minneapolis, Minn	77
Angers (1872-1900)	3	3	1	7	Bismarck, N. Dak	89
Langres (1889-1900)	11	11	6	28	Denver, Colo	23
Besançon (1885-1900)	6	8	3	17	Salt Lake City, Utah	22
Nice (1885-1900)	0	0	0	0	Seattle, Wash	2
Marseille (1881-1900)	0	1	0	1	San Francisco, Cal	0
Montpellier (1881-1900)	0	0	0	0	Santa Fe, N. Mex	14
Perpignan (1881-1900)	0	1	0	1	San Antonio, Tex	1
Toulouse (1881-1900)	1	2	0	3	New Orleans, La	0
Bordeaux (1881-1900)	1	2	0	3	Atlanta, Ga	3

AUTHORITIES:
Annales du Bureau Central Météorologique de France, 1904.
U. S. Weather Bureau—Climatological data for the States, 1895-1914.

TABLE 6.—*Average monthly and annual precipitation at selected stations in France and Belguim.*

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
France: [a]	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Dunkirk	2.16	1.54	1.69	1.65	1.89	2.13	2.44	2.87	2.80	3.19	3.23	2.60	28.19
Lille	2.13	1.81	2.20	1.65	2.24	2.28	2.76	2.52	2.52	3.03	2.81	2.48	28.46
Albert	2.00	1.65	1.89	1.54	2.13	2.24	2.68	2.20	2.24	2.48	2.36	2.28	25.69
Paris	1.42	1.10	1.46	1.54	1.85	2.09	1.97	1.85	1.89	2.13	1.89	1.58	20.77
Rouen	2.17	1.69	2.05	1.77	2.09	2.28	2.68	2.48	2.52	2.76	2.68	2.56	27.73
St. Malo	2.72	2.13	2.32	2.21	2.28	2.52	2.44	2.28	2.91	3.78	3.66	3.23	32.48
Brest	3.31	2.95	2.24	2.13	1.93	2.01	2.09	2.13	3.07	3.58	3.78	3.23	32.45
Joinville	2.64	2.52	2.81	2.28	2.52	3.31	3.58	3.35	3.03	3.74	3.62	3.19	36.62
Besançon	3.11	2.60	3.39	3.50	3.90	4.41	3.66	3.50	3.42	4.61	4.09	3.43	43.62
Moulins	1.42	1.34	1.69	2.01	2.21	2.95	2.44	2.40	2.32	2.44	1.89	1.54	24.65
Lyon	1.34	1.42	2.13	2.64	3.27	3.35	3.42	3.27	2.95	3.78	2.56	1.93	32.06
Clermont Ferrand (near Puy-de-Dôme)	1.10	1.14	1.34	1.65	2.36	2.80	2.24	1.97	2.24	2.24	1.50	1.26	21.84
Marseille	1.93	1.38	1.81	2.05	1.57	1.02	0.51	0.99	2.40	3.47	2.99	2.20	22.32
Montpellier	3.46	2.52	2.40	2.52	2.28	1.46	0.91	2.09	2.76	4.53	3.07	2.91	30.91
Toulouse	1.81	1.57	1.97	2.80	2.80	3.07	1.69	1.93	2.28	2.60	1.93	1.65	26.22
Perpignan	1.85	1.65	1.93	1.97	1.93	1.38	0.87	0.91	1.77	2.60	1.38	1.50	19.74
Bagnères	3.66	3.66	4.72	5.12	4.80	5.05	2.42	2.72	3.27	4.20	4.45	3.19	47.32
Bordeaux	2.80	2.28	2.52	2.64	2.91	3.19	2.01	2.16	2.60	3.70	3.66	2.91	33.38
Belgium:													
Ostend [b]	2.05	1.57	1.89	1.51	1.93	1.93	2.24	2.91	2.76	2.56	3.11	2.28	26.77
Ghent [c]	2.28	1.89	2.01	1.93	2.40	2.72	3.11	3.19	2.83	3.39	2.95	2.76	31.46
Louvain [d]	2.28	2.09	2.20	1.93	2.13	3.15	2.68	2.83	2.36	2.28	2.84	1.89	28.66
Namur [e]	1.73	1.42	1.61	1.77	2.05	2.60	2.95	2.84	2.13	2.32	1.97	2.28	25.67
Liége [f]	2.09	1.93	1.97	2.05	2.36	2.79	2.91	3.19	2.48	2.72	2.48	2.52	29.49
Brussels [g]	2.20	1.85	1.97	1.85	2.28	2.52	2.87	3.03	2.56	2.80	2.52	2.40	28.85

[a] Period 1861-1890.
[b] Period 1861-1882.
[c] Period 1838-1874, 1878-1890.
[d] Period 1836-1848.
[e] Period 1849-1863, 1877-1890.
[f] Period 1847-1890.
[g] Period 1833-1896.

AUTHORITIES:
France—Annales du Bureau Central Météorologique de France, 1895.
Belgium—*Lancaster*—La Pluie en Belgiqne. Bruxelles, 1894.

TABLE 7.—*Average number of days with precipitation, trace or more, for the 5-year period 1907-1911, at selected stations in France and in the United States.*

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
France:	das.	das.	das.	das.	das.	das.	das.	das.	das.	das.	das.	das.	das.
Nancy	13	16	14	13	14	14	14	12	11	13	17	19	170
Paris	16	17	17	17	17	16	14	11	12	16	16	19	188
Arras	19	19	19	17	15	15	18	14	16	19	22	22	215
Brest	17	16	21	17	13	14	11	11	10	22	20	25	197
Marseille	6	5	12	10	10	8	3	3	8	13	10	13	101
United States:													
New York, N. Y	18	15	16	15	16	13	10	14	11	11	14	13	166
Washington, D. C	17	14	16	16	16	16	14	15	11	11	12	13	171
Atlanta, Ga	13	13	11	14	14	14	19	15	10	8	11	14	156
Chicago, Ill	19	15	14	18	16	13	13	12	13	11	15	19	178
St. Louis, Mo	14	14	11	15	15	15	13	11	12	11	9	14	154
New Orleans, La	10	10	8	12	13	16	20	21	17	9	9	14	159
Denver, Colo	6	8	8	11	16	13	17	17	12	9	7	9	133
Salt Lake City, Utah	14	13	14	12	12	11	9	11	9	9	8	14	136
Seattle, Wash	22	20	18	16	15	12	7	6	11	15	21	20	183
San Francisco, Cal	21	15	14	6	7	4	3	1	4	7	7	13	102

AUTHORITIES:
France—Annales du Bureau Central Météorologique de France, 1907-1911.
United States—*Weather Bureau*—Climatological data for the States, 1907-1911.

TABLE 8.—*Average number of days with precipitation from 0.25 to 1.00 inch, for the 5-year period 1907-1911, at selected stations in France and the United States.*

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
France:	das.	das.	das.	das.	das.	das.	das.	das.	das.	das.	das.	das.	das.
Nancy	2	3	2	1	2	5	4	2	2	4	4	5	36
Paris	1	1	1	2	3	3	2	2	2	5	3	3	28
Arras	3	2	1	3	4	4	3	1	2	5	4	5	37
Brest	3	3	3	2	2	1	2	1	2	6	5	6	36
Marseille	1	1	2	3	1	1	0	1	2	4	3	3	22
United States:													
New York, N. Y	4	4	3	4	3	4	2	2	3	3	3	3	38
Washington, D. C	4	4	3	3	4	4	3	3	2	3	3	3	39
Atlanta, Ga	3	5	3	4	4	4	3	4	3	3	2	4	42
Chicago, Ill	3	3	3	4	6	4	3	2	2	2	3	3	38
St. Louis, Mo	2	3	3	4	4	4	2	3	4	2	4	2	37
New Orleans, La	2	3	1	2	3	4	4	4	5	2	2	3	35
Denver, Colo	0	0	0	1	3	1	2	3	1	0	1	1	13
Salt Lake City, Utah	2	3	3	2	4	1	0	2	2	3	2	2	26
Seattle, Wash	6	5	2	2	3	1	0	0	2	3	6	6	36
San Francisco, Cal	8	5	5	0	0	0	0	0	0	1	2	4	25

AUTHORITIES: Same as for Table 7 above.

TABLE 9.—*Total number of days with precipitation from 1.01 to 2.00 inches, and with more than 2.00 inches, for the 5-year period 1907–1911, at selected stations in France and in the United States.*

France.			United States.		
Stations.	1.01 to 2.00 inches.	Over 2.00 inches.	Stations.	1.01 to 2.00 inches.	Over 2.00 inches.
	Days.	*Days.*		*Days.*	*Days.*
Nancy	5	0	New York, N. Y	36	9
Paris	3	0	Washington, D. C	39	6
Arras	1	0	Atlanta, Ga	42	8
Brest	1	1	Chicago, Ill	30	3
Marseille	9	4	St Louis, Mo	47	4
			New Orleans, La	63	29
			Denver, Colo	9	1
			Salt Lake City, Utah	3	0
			Seattle, Wash	16	0
			San Francisco, Cal	17	2

AUTHORITIES: Same as for Tables 7 and 8 above.

TABLE 10.—*Average number of days with snowfall, at stations in France and United States.*

Stations.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Annual.
France:							
Paris—Parc St. Maur (1873–1903)[a]	1	3	4	3	3	1	15
Montdidier (1784–1869)[b]	1	3	4	3	3	1	15
Fécamp (1853–1882)[c]	0	2	2	2	2	0	8
Brussels, Belgium (1833–1850)[d]	1	4	6	5	5	2	23
United States:							
New York	.....	.....	.....	.....	.....	.....	20
Washington	.....	.....	.....	.....	.....	.....	14
Atlanta, Ga	.....	.....	.....	.....	.....	.....	7
Chicago, Ill	.....	.....	.....	.....	.....	.....	30
Kansas City, Mo	.....	.....	.....	.....	.....	.....	19
Oklahoma, Okla	.....	.....	.....	.....	.....	.....	7
Denver, Colo	.....	.....	.....	.....	.....	.....	33

[a] Annuaire de la Société Météorologique de France, 1905 (Paris).
[b] Annales du Bureau Central Météorologique de France, 1895.
[c] Annales du Bureau Central Météorologique de France, 1885.
[d] *Quetelet:* Climat de la Belgique, Bruxelles, 1857.
For the United States, see Table 8 above.

TABLE 11.—*Average cloudiness, in percentages of total sky, at selected station in France and Belgium and in the United States.*

The values given in this table for France and Belgium are averages for the various hours of observation and probably approximate the daily averages, the records in most cases covering periods of at least 10 years. Those for the United States represent the normal average daily cloudiness, *sunrise to sunset*, for a long period of years.

Stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
France:	%	%	%	%	%	%	%	%	%	%	%	%	%
Dunkirk	72	71	63	59	57	58	55	63	60	71	79	72	65
Paris—Parc St. Maur	73	72	65	59	56	51	55	49	51	53	62	71	60
Rouen	65	64	58	56	51	52	49	52	58	61	67	67	58
Brest	71	71	70	64	56	67	64	60	61	66	75	64	66
Angers	68	61	57	56	52	53	54	53	56	61	69	69	59
Nantes	75	66	63	64	58	60	57	54	56	61	75	66	63
Besançon	60	64	58	55	51	53	48	48	49	59	65	65	55
Cluny	62	53	57	53	45	43	39	39	39	61	63	65	52
Nice	36	34	32	43	38	29	25	33	33	37	33	34	34
Marseille	47	47	41	46	46	36	23	30	42	44	42	49	41
Montpellier	39	38	36	40	36	31	26	28	35	39	40	41	36
Toulouse	68	57	57	59	57	55	44	45	50	52	61	66	56
Brussels, Belgium	77	78	71	62	63	67	63	65	58	65	75	79	69
United States:													
New York	58	54	56	54	53	51	51	51	48	48	54	56	53
Washington	58	54	55	50	50	48	46	48	45	45	51	54	50
Atlanta	57	55	51	49	47	50	54	54	47	38	45	53	50
Chicago	59	56	57	52	48	47	40	40	43	48	58	61	52
St. Louis	53	54	55	51	50	48	44	39	38	35	51	58	48
New Orleans	54	53	49	47	44	47	52	50	43	38	46	53	48
Denver	37	40	46	49	52	41	44	44	35	36	37	38	41
Salt Lake City	59	58	55	51	47	34	30	34	30	38	47	58	45
Seattle	77	71	64	60	65	58	42	42	56	67	75	79	63
San Francisco	53	49	48	41	40	35	41	43	33	35	42	50	43

AUTHORITIES:
France—Annales du Bureau Central Météorologique de France, 1884.
United States, as above.

TABLE 12.—*Prevailing wind directions and average relative humidities for Sèvres, Brussels, and Montpellier.*

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
	Prevailing winds.												
Sèvres (10 years)	SW	SW	W	SW	NE	W	W	W	W	SW	SW	SW	SW
Brussels (8 years)	SW	SW	SW	SW	SW	N	SW	SW	SW	SW	SW	SW	SW
	Average relative humidity.												
Sèvres (10 years)	%	%	%	%	%	%	%	%	%	%	%	%	%
7 a. m	89	89	89	79	73	72	76	82	90	94	92	92	....
12 noon	78	69	60	51	51	51	54	55	58	68	76	80	....
9 p. m	86	82	78	72	74	76	77	79	83	90	90	89	....
Montpellier (14 years):													
9 a. m	82	76	70	67	62	58	56	57	66	71	80	80	....

AUTHORITIES: Annual reports of the French and Belgian meteorological services.

FOG ALONG THE CALIFORNIA COAST.

By ANDREW H. PALMER, Observer.

[Dated: Weather Bureau office, San Francisco, Cal., Oct. 15, 1917.]

When the Marine Exchange of the San Francisco Chamber of Commerce was asked what proportion of shipwrecks occurring along the California coast was due to fog, the reply was, "All of them." That exchange keeps a detailed record of all marine disasters occurring in the Pacific Ocean. The records previous to 1906 are no longer available, as they were destroyed in the fire which followed the San Francisco earthquake of April 18, 1906. But the record kept since that date is voluminous, for many shipwrecks have occurred. A cursory examination of this record showed that nearly all of those which occurred along the California coast were indirectly due to fog. The winds along the coast of California, though occasionally strong, are seldom of destructive violence. Hurricanes are practically unknown. Storms of the type which sweep the Atlantic coast of the United States every winter are of rare occurrence. At Point Reyes local winds often exceed 100 miles per hour in velocity, and the records include some of the highest winds ever recorded at sealevel in the United States. But these velocities, while true, are restricted to the immediate vicinity of the Point, and never occur along the routes followed by steamers. Along the California coast, clear-weather gales seldom cause more inconvenience to shipping than delayed schedules. But fog, which is unfortunately of frequent occurrence, and often of long duration, is a serious obstacle, and is without question the greatest menace to navigation.

Though there has been an increasing demand on the part of mariners for trustworthy fog data, the Weather Bureau, until recently, has been unable to render effective service in this matter. Though situated near the coast, the regular Weather Bureau stations at Eureka, San Francisco, San Luis Obispo, Los Angeles, and San Diego were nevertheless too far removed from the steamer lanes to secure the desired data. However, during the

summer of 1916, an arrangement was effected between the Lighthouse Service and the Weather Bureau whereby the latter secures a report each month showing the number of hours of dense fog at each of 41 fog signal stations. (Throughout this discussion all references to "fog" imply "dense fog," the technical term used in the Weather Bureau describing the condition under which objects are invisible at a distance of 1,000 feet. No cognizance is here taken of light fog, where objects are visible at a greater distance than that named.) At these 41 stations, all but three of which are lighthouses, there are various kinds of fog signals in operation during times of fog, both by day and by night, and the keepers are instructed to keep an accurate record of the time. These reports are collected each month by the lighthouse inspector, San Francisco, who in turn forwards copies to the Section Centerof the Weather Bureau, at Sacramento, Cal., where they are published monthly in the "Climatological Data for the California Section."

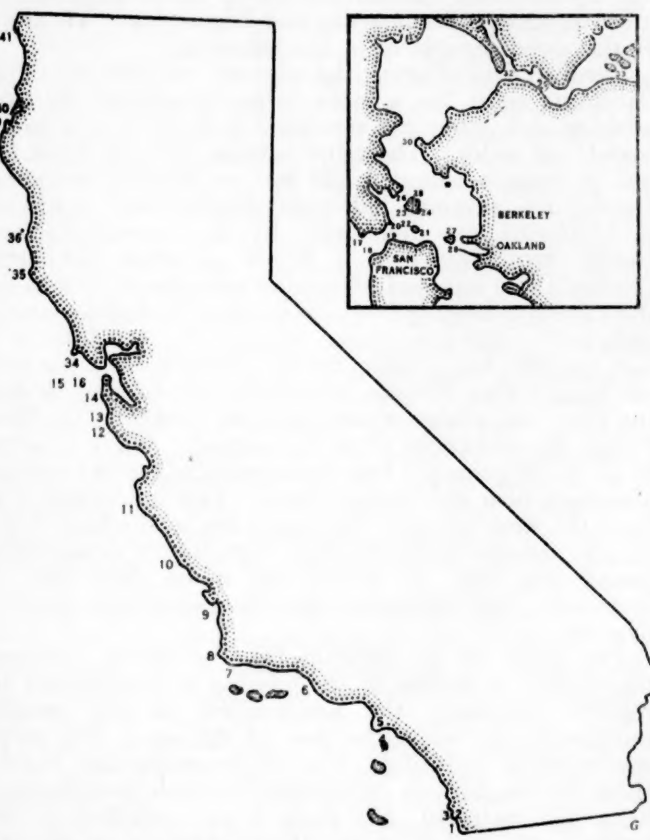

FIGURE 1.—Outline map of California indicating by reference numbers the approximate positions of fogsignal stations given in Tables 1 and 2. (Insert: Detail of San Francisco Bay stations.)

Table 1 gives the names of the 41 fog signal stations, the latitude and the longitude of each, the height of the light above high tide, and the kind of fog signal in use. The stations at Blunts Reef and San Francisco Light Vessel are on board vessels which are anchored in fixed positions in the steamer lanes. All the others are on headlands, rocks, or breakwaters closely adjacent to the routes followed by coastwise steamers, or those entering or leaving port. About one-half of these are situated in or near San Francisco Bay. The approximate positions of the 41 fog signal stations from which reports are received are shown graphically in figure 1, in which the numbers given refer to those stated in Table 1.

28022—17——2

TABLE 1.—*Fog signal stations on the coast of California.*

Ref. Nos.	Lighthouse.	Latitude North.			Longitude West.			Height of light above high tide.*	Fog signal machinery.
		°	′	″	°	′	″	*Feet.*	
1	Point Loma	32	39	55	117	14	32	88	First-class air siren.
2	Ballast Point	32	41	11	117	13	58	34	Bell.
3	La Playa	32	42	11	117	14	05	28	Do.
4	Los Angeles Outer Harbor.	33	42	31	118	15	03	73	First-class air siren.
5	Los Angeles Inner Harbor.	33	43	15	118	16	13	(a)	Bell.
6	Point Hueneme	34	08	45	119	12	34	52	First-class air siren.
7	Point Conception	34	26	56	120	28	13	133	Air diaphone.
8	Point Arguello	34	34	41	120	39	00	100	First-class air siren.
9	San Luis Obispo	35	09	38	120	45	37	130	Do.
10	Piedras Blancas	35	39	57	121	17	01	158	Do.
11	Point Sur	36	18	24	121	54	03	270	Do.
12	Ano Nuevo Island	37	06	20	122	20	10	73	Do.
13	Pigeon Point	37	10	56	122	23	36	148	Do.
14	Point Montara	37	32	15	122	31	06	70	12-inch steam whistle.
15	Farallon Islands	37	41	58	123	00	04	358	Air diaphone.
16	San Francisco Light Vessel.	37	45	03	122	41	30	57	12-inch steam whistle.[b]
17	Bonita Point	37	48	57	122	31	44	124	First-class steam siren.
18	Mile Rocks	37	47	35	122	30	35	78	10-inch air whistle.
19	Fort Point	37	48	39	122	28	36	81	Air diaphone.
20	Lime Point	37	49	33	122	28	39	19	12-inch steam whistle.
21	Alcatraz Island, South Side.	37	49	36	122	25	17	214	Electric siren.
22	Alcatraz Island, North Side.	37	49	43	122	25	28	(a)	Do.
23	Angel Island	37	51	23	122	26	31	34	Bell.
24	Point Blunt	37	51	10	122	25	04	60	Electric siren.
25	Immigration Station	37	52	17	122	25	33	20	Bell.
26	Point Stuart	37	51	40	122	26	42	80	Electric siren.
27	Goat Island	37	48	28	122	21	41	95	10-inch steam whistle.
28	Oakland Harbor	37	48	02	122	19	51	43	Bell.
29	Southampton Shoal	37	52	56	122	23	58	52	Do.
30	East Brother Island	37	57	49	122	25	58	61	12-inch steam whistle.
31	Mare Island	38	04	26	122	15	15	74	Bell.
32	Carquinez Strait	38	04	15	122	14	32	56	First-class air siren.
33	Roe Island	38	04	07	122	01	40	41	Bell.
34	Point Reyes	37	59	45	123	01	21	294	Air diaphone.
35	Point Arena	38	57	19	123	44	24	155	First-class air siren.
36	Point Cabrillo	39	20	56	123	49	31	84	Do.
37	Punta Gorda	40	15	03	124	20	57	75	Do.
38	Blunts Reef	40	26	04	124	30	14	50	12-inch steam whisthe.[b]
39	Humboldt Table Bluff	40	41	45	124	16	24	176	First-class air siren.
40	Humboldt Bay	40	45	41	124	13	18	(a)	Do.
41	St. George Reef	41	50	15	124	22	28	146	Do.

* Fog signals are sometimes at a different altitude.
[a] No light.
[b] Also a submarine bell.

DURATION OF FOG.

Table 2 summarizes the duration of fog at 41 fog signal stations of California for a period of one year. So far as is known, this is the first time such complete fog data collected along the California coast and covering a year of time, have been assembled and published.[1] The year was an ordinary one from a meteorological standpoint, and may safely be regarded as typical. The summary presents interesting details. The summer months had the most fog, the greatest amount having occurred in September. The winter months had the least fog, the smallest amount having occurred in March. During August, 1917, Humboldt Table Bluff had 442 hours of fog, or 59 per cent of the month; at Blunts Reef during the same month there were 418 hours of fog, or 56 per cent of the month. At Point Reyes, where the sun is sometimes hidden by fog for three and four weeks at a time, there were 370 hours of fog during July, 1917, or 51 per cent of that month. On account of its persistent fog mantle, Point Reyes has the unique distinction of being the coolest place in the United States during the midsummer months.

[1] See, however, *U. S. Bureau of Lighthouses.* The United States Lighthouse Service, 1915. Washington, 1916. Also this REVIEW, January, 1916, 44: 21, and the present issue, p. 499.

It is apparent from the table that from Point Arguello northward fog is of frequent occurrence, particularly during the summer months. Point Arguello, where the fogs are invariably thick, is recognized among mariners to be one of the most dangerous points on the Pacific Coast. The Golden Gate, the entrance to San Francisco Bay, is also a region of frequent fog, and shipwrecks have been numerous as a result. Most prominent of these was the wreck, on Fort Point Reef, on February 22, 1901, of the steamer *Rio de Janeiro* with the loss of 127 lives. Near Blunts Reef, another region of excessive fog, the passenger steamer *Bear*, valued at more than $1,000,000, went ashore in the summer of 1916 during a dense fog. Five lives were lost and the vessel is still breaking up on the beach. In the immediate vicinity of Humboldt Bay, the harbor of Eureka, a total of 19 shipwrecks have occurred in the past 10 years, all due indirectly to fog. Notable among these was the stranding, during January, 1917, of U. S. submarine *H-3* during a fog. Though this vessel was finally salvaged, the U. S. S. *Milwaukee* (9,700 tons displacement), in attempting to rescue her went ashore during a fog and was a total loss. No large vessel has ever been refloated from these shoals, and many have found graves there.

TABLE 2.—*Duration of fog (hours) at fog signal stations on the coast of California September, 1916, to August, 1917.*

[Authority: U. S. Lighthouse Service.]

Ref. Nos.	Lighthouse.	1917.								1916.				Year.	
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	Per cent.
		Hr.	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	*Hr.*	
1	Point Loma	3	22	31	9	0	75	6	0	10	26	47	40	269	3
2	Ballast Point	4	22	11	8	0	44	2	0	11	22	68	51	243	3
3	La Playa	7	21	11	11	0	51	1	0	22	35	81	50	290	3
4	Los Angeles Outer Harbor	51	68	47	49	10	51	28	15	98	83	105	91	696	8
5	Los Angeles Inner Harbor	31	43	27	22	1	32	4	18	79	52	65	69	433	5
6	Point Hueneme	12	25	18	43	4	59	44	34	102	101	67	36	545	6
7	Point Conception	13	31	2	29	1	50	111	15	81	16	41	29	419	5
8	Point Arguello	14	40	26	124	32	100	357	108	230	28	68	70	1,197	14
9	San Luis Obispo	1	27	3	83	17	73	345	86	236	42	20	80	1,013	12
10	Piedras Blancas	14	33	20	93	23	54	356	76	280	26	49	68	1,092	12
11	Point Sur	7	36	43	76	22	98	204	103	252	54	30	38	963	11
12	Ano Nuevo Island	36	52	36	84	15	71	150	62	258	67	50	101	982	11
13	Pigeon Point	22	49	34	75	10	63	151	53	231	73	44	72	877	10
14	Point Montara	42	69	48	87	36	94	156	65	264	109	36	74	1,080	12
15	Farallon Island	28	96	56	107	33	85	171	111	223	79	28	46	1,063	12
16	San Francisco Light Vessel	88	146	53	102	31	129	239	250	304	178	48	122	1,690	19
17	Bonita Point	70	85	27	100	16	78	145	68	281	91	51	74	1,086	12
18	Mile Rocks	52	71	27	69	21	75	136	69	251	84	40	57	952	11
19	Fort Point	60	68	11	80	8	62	133	74	238	86	48	69	937	11
20	Lime Point	52	61	22	66	6	60	118	49	235	77	40	62	848	10
21	Alcatraz Island, South Side	53	42	14	28	1	44	105	41	159	45	27	40	599	7
22	Alcatraz Island, North Side	56	48	18	39	2	50	82	50	185	53	33	46	662	8
23	Angel Island	18	9	10	8	0	0	13	0	11	11	10	10	100	1
24	Point Blunt	45	35	13	24	0	28	72	29	132	36	17	29	460	5
25	Immigration Station	1	9	3	0	0	0	0	0	3	25	3	1	45	1
26	Point Stuart	25	9	10	3	0	0	7	0	9	14	10	11	98	1
27	Goat Island	36	10	6	3	0	0	1	0	11	23	17	15	122	1
28	Oakland Harbor	26	11	4	0	0	0	0	0	9	11	9	10	80	1
29	Southampton Shoal	34	14	8	6	0	6	14	1	15	26	13	12	149	2
30	East Brother Island	37	12	10	3	0	0	2	0	3	23	22	5	120	1
31	Mare Island	66	16	4	6	....	0	5	0	4	31	21	22	175	2
32	Carquinez Strait	77	19	8	7	0	0	5	7	5	31	20	21	200	2
33	Roe Island	75	8	0	1	0	0	0	0	0	16	9	30	139	2
34	Point Reyes	86	179	67	158	96	158	370	326	313	167	70	117	2,107	24
35	Point Arena	14	84	40	74	35	108	301	232	214	110	22	60	1,294	15
36	Point Cabrillo	11	69	56	49	33	130	280	275	191	132	19	53	1,298	15
37	Punta Gorda	9	20	54	35	14	95	134	143	166	79	9	22	780	9
38	Blunts Reef	54	106	77	99	89	148	251	418	186	140	31	84	1,683	19
39	Humboldt Table Bluff	53	127	28	60	81	161	253	442	195	175	50	60	1,685	19
40	Humboldt Bay	60	118	29	35	26	134	141	257	228	223	77	74	1,402	16
41	Saint George Reef	13	52	17	34	39	130	135	361	136	174	41	12	1,144	13
	Means: Number of hours	35.5	50.3	25.1	48.5	17.1	63.3	122.6	93.4	143.0	70.1	38.0	49.6	756.5	9
	Per cent	5	7	3	7	2	9	17	13	19	9	5	7	9	...

Since fog can not directly cause shipwreck, its influence is always indirect, and it is almost invariably aided and abetted by a strong current or brisk winds. A treacherous undercurrent occurs at many points along the Pacific coast, causing a vessel to "set" as the navigators term it. However, fog remains the principal contributing cause, since few shipwrecks would occur along the coast of California if there were no fog. When for days at a time navigators are unable to determine a ship's position by the usual astronomical methods, navigation is necessarily hazardous. Even when the position is known there is danger of collision with another vessel. Cautious navigators therefore usually proceed at slow speed during a fog, if they proceed at all.

THE NATURE OF FOG ALONG THE CALIFORNIA COAST.

The nature of California coast fog has long been known to meteorologists, but a brief description would seem appropriate here. Broadly speaking, it may be separated into two classes, Summer fog and Winter fog. These will be discussed separately in the following:

Summer fog.—During the summer months the entire California coast has a more or less persistent fog bank offshore and extending westward a distance of approximately 50 miles. The bank seldom exceeds 2,000 feet and is usually about 1,500 feet in vertical thickness. During the summer half-year, atmospheric conditions in California are dominated by the extensive North Pacific HIGH, which is a region of weak barometric gradients and hence of little wind movement. However, the excessive heating from insolation of the great interior valleys of California causes the air over the interior to rise, its place being taken by air drawn in from the west, the high Sierra Nevada preventing air coming in from the east. At places where there are breaks in the Coast Range the indraught of air is marked. Wind velocities of 25 to 30 miles per hour occur regularly every summer afternoon near the Golden Gate. This indraught of air from the west brings in the ocean fog to the land, but it usually dissipates or becomes high fog or cloud before penetrating far. It should be noted that the fog originates over the ocean and occasionally is drawn in over the land.

The origin of the summer type of fog is principally the mixing of masses of air differing in temperature and relative humidity, the temperature of the resulting mixture being below the dew of the mass and partial condensation resulting. Various investigations, notably those by the Scripps Institution for Biological Research, have demonstrated that there is an upwelling of relatively cold water along the California coast. The temperature of the surface water near the coast is distinctly lower than that farther west. During the summer months of anticyclonic control, when there is a diminished gradient and little cyclonic wind movement, the air over this region of relatively cold water is also relatively cold, as well as almost saturated. As the superincumbent air receives little or no heat from the cold surface water, it cools and therefore approaches its dewpoint. Moreover, the indraught over the interior, of air from the west, reinforces the prevailing westerly winds, and causes a slow but well-defined west to east movement. Over the upwelling water there is a mixing of the relatively cold and almost saturated local air with slightly warmer air coming in from a more westerly region. The latter air is also almost staurated because of the wide expanse of ocean surface over which it has passed. In the mixing the dewpoint is reached, and a portion of the invisible water vapor is condensed to form the visible

moisture particles which collectively are known as fog. Fog is simply a cloud in contact with the land or the ocean.

As the summer type of fog is principally due to the mixing of air masses differing in relative humidity and in temperature, it seldom results in measurable precipitation. Air masses which ascend and therefore expand and cool produce precipitation much more effectively. Though it is foggy along the California coast about 50 per cent of the time during the summer months, practically no precipitation is recorded. Certain kinds of vegetation have, through a long-continued process of adapting themselves to their environment, learned to precipitate water from the fog. For example, the redwood (*Sequoia sempervirens*), one of the most typical of California trees, has so successfully learned the art of precipitating mositure from fog that such a grove is dripping wet during a fog. It is a significant fact that this tree is found only in a narrow belt along the coast, and never more than 30 miles inland. Recent determinations show that the amount of liquid water in the densest fogs is very small;[2] but large areas collect large amounts and perhaps some day irrigation will be aided by the use of some device for precipitating water from fog as successfully as the redwood tree does it.

Winter fog.—Winter fog is less common than the summer type, and differs from it also in being of land origin. It occurs in all portions of California, and occasionally moves seaward, though it does not often go far offshore. It is very superficial, usually being but 100 to 200 feet deep. However, it resembles the summer type of fog in that it requires a weak barometric gradient for its formation, and vigorous wind movement prevents it from forming. It can be anticipated during the winter when a large high pressure area impinges upon the coast, and subsequently moves slowly southeastward. In California it is locally known as "tule fog" as it is of most frequent origin over tule lands which are swamps and marshes filled with tule or Mexican bulrush of the genus Scirpa. During the night, when stagnant air lies in contact with moist ground it loses heat through radiation aloft and through conduction to the ground. If the lowering of temperature proceeds far enough, partial condensation results in the formation of a "tule fog." This fog will persist until it is dried up by the sun from above, or is laterally displaced by cyclonic wind movement. As a factor in navigation it is less dangerous than summer fog because it is less frequent, is very shallow, and is not found far offshore. Navigators can often avoid it by taking an outside course. Occasionally, a lookout stationed at the top of the mast can see over the fog stratum, thus largely removing the danger of running ashore.

In California and vicinity the barometric conditions of Summer are wholly different from those of Winter. So, too, are the fogs, which are largely dependent on barometric gradients and the resulting winds. While the summer type of fog occasionally occurs in winter, it is uncummon, because the Aleutian LOW then controls the weather of the North Pacific. The air is then cooler than the water, and contact between the two causes a rise in the temperatire of the air rather than a fall, and hence a tendency to dispel fog.

SUMMARY.

Fog is the principal contributing cause of most of the marine disasters along the coast of California. When a ship is wrecked through going ashore or by collision, it is usually during a period of fog. Fog prevails during a large part of the time, approximately 50 per cent of the summer months being foggy. Summer fogs originate over the ocean, are due primarily to the mixing of air masses differing in temperature and relative humidity, and coincide in extent largely with the upwelling of relatively cold water. Winter fogs, of land origin, are shallow in depth, and are caused by the cooling and partial condensation of the mositure in a stagnant mass of air lying in contact with moist ground. Both types of fog are associated with anticyclonic conditions, for they are dispelled by well-defined gradients and the resulting winds.

BIBLIOGRAPHY.

The fogs occurring in California are treated in the following publications:

McAdie, A. G. Climatology of California. Washington, 1903. Weather Bureau bull. L.) Chapter "Fog", pp. 239-249.

Fog and fog signals. *In* Meteorological Chart of the North Pacific Ocean, April 1904.- Supplement. [U. S. Hydrographic Office, Washington, ?].

Holway, R. S. Cold-water belt along the west coast of the United States. Univ. Cal. public. in Geology, Berkeley, Cal., 1905, **4**: 263-286.

Thorade, H. Ueber die Kalifornische Meeresströmungen. Annalen der Hydrographie u. marit. Meteorologie, **37**:17-34, 63-77.

McEwen, Geo. F. The distribution of ocean temperatures along the west coast of North America. Internat. Revue d. gesamten Hydrobiologie u. Hydrographie, **5**:243-286.

Peculiarities of the California climate. Monthly Weather Review, 1914, **42**:14-23.

Wright, H. H. Fog in relation to wind direction on Mount Tamalpais, Cal. Monthly Weather Review, 1916, **44**:342-344.

RELATIVE FREQUENCY OF FOG AT UNITED STATES LIGHTHOUSES.[3]

UNITED STATES BUREAU OF LIGHTHOUSES

Fog is more generally prevalent throughout the first district than any other, as shown by the following table, from which it will be seen that out of 29 stations in the entire service, averaging over 1,000 hours of fog per year, 14 or practically one-half are in that locality.

District.	Station.	Average hours of fog per year.	Length of record.	Per cent of fog based on entire period.
		Hours.	*Years.*	*Per cent.*
1	Petit Manan, Me.	1,691	31	19
1	Whitehead, Me.	1,544	31	18
1	Libby Islands, Me.	1,536	31	17
1	Matinicus Rock, Me.	1,399	31	16
1	Great Duck Island, Me.	1,384	25	16
1	West Quoddy Head, Me.	1,372	31	16
1	Moose Peak, Me.	1,356	3	15
1	Egg Rock, Me.	1,341	11	15
18	Point Reyes Light, Cal.	1,337	31	15
1	Seguin, Me.	1,331	31	15
1	Mount Desert, Me.	1,304	24	15
1	Little River, Me.	1,219	10	14
1	The Cuckolds, Me.	1,208	23	14
17	Swiftsure Bank Light Vessel, Wash.	1,203	9	14
12	Calumet Harbor, Ill.	1,196	9	14
1	Pollock Rip Slue Light Vessel, Mass.	1,175	14	13
18	Bonita Point, Cal.	1,143	31	13
1	Manana Island, Me.	1,116	31	13
18	Point Arena, Cal.	1,076	31	12
18	Blunts Reef Light Vessel, Cal.	1,065	10	12
2	Great Round Shoal Light Vessel, Mass.	1,064	23	12
1	Nash Island, Me.	1,063	10	12
2	Pollock Rip Light Vessel, Mass.	1,061	31	12
18	Point Cabrillo, Cal.	1,045	7	12
18	Humboldt, Cal.	1,037	7	12
18	San Luis Obispo, Cal.	1,027	25	12
2	Nantucket Shoals Light Vessel, Mass.	1,005	23	11
18	San Francisco Light Vessel, Cal.	1,004	18	11
2	Gloucester Breakwater, Mass.	1,002	4	11

[2] *United States Coast Guard.* International ice observation and ice patrol service in the North Atlantic Ocean, February to July, 1915. Washington, 1916, pp. 65-72. (U. S. Coast Guard, bulletin No. 5.)

[3] Quoted from *U. S. Bureau of Lighthouses.* The United States lighthouse service, 1915. Washington, 1916. 94 p. 8°. See p. 49.

GLAZE; "GLAZED ROADS"; "AMMIL."

The "Observer's Handbook" of the Meteorological Office of Great Britain applies the name "glazed frost" to the smooth coating of ice formed by rain freezing as it falls. This is the English equivalent for the French "verglas," the German "Glatteis"; and in 1916 the United States Weather Bureau, after discussing various known usages, adopted the name "glaze" for the phenomenon. (This REVIEW, May, 1916, **44**:286.) The word "glaze" was chosen finally on the basis of its use in this precise sense by Morse in 1796.

It is interesting to read in the (Gr. Br.) Meteorological Office Circular No. 9, January 29, 1917, the following suggestion:

GLAZED ROADS.

In the Observer's Handbook the term "Glazed frost" is used to describe the smooth coating of ice which is formed by rain freezing as it falls, and no special name is given to the state of things which exists when frost sets in suddenly after a partial thaw[1] of snow. It is desirable that the circumstances, which are of importance owing to the danger to traffic, should not pass unrecorded. The term "glazed roads" has been suggested as indicating the state of the roads without reference to the precise cause.

The Meterological Office seems here tacitly to recognize some advantage in the American proposal; but the "glazed roads" seem to be quite adequately covered by the comprehensive American term "ice storm" which, to an American, at once suggests not only ice-loaded wires and trees but roads and walks rendered impassable by "glaze."

"AMMIL."

Related to these frozen hydrometeors is the phenomenon known in Dartmoor as "ammil." The issue of the Meteorological Office Circular, January 29, 1917, cited above, contains the following communication from Rev. H. H. Breton:

This is not the glazed frost [glaze] you are accustomed to, but due to *damp air* which deposits a lot of moisture on the frozen objects. All Dartmoor folk call it "the Ammil," probably derived from "enamel." Slight ammil is not uncommon on Dartmoor; good displays are rare.

The following from Wright's English Dialect Dictionary, Vol. I (Oxford University Press, London [1898]), is here pertinent:

Ammil (*a* pronounced as in bat). A kind of hoarfrost. Devonshire. There is one peculiar atmospheric phenomenon seen upon Dartmoor which is of rare occurrence, . . . known to the moorfolk as the "ammil." . . . Under certain conditions a body of thin, transparent ice incloses every tree, twig, leaf, or blade of grass.—*Page*, Explorations in Dartmoor, 1889, v. 1.

Do look; the trees be looking beautiful this morning. Looks as if they was covered with diamonds.—*Hewett*, Peasant Sp. 1892.

The exact conditions of formation of "ammil" are not altogether cleared up by these last two quotations. Certainly the descriptions and the definition quoted from Wright seem to place "ammil" with Glatteis (glaze); but the present explicit statement by Breton that "ammil" is not the "glaze" we are accustomed to, and the manner of its formation as stated by him, induce the writer to believe that it resembles the delicate deposit described by Friederich Ratzel[2] in 1889, viz, a very fine-grained botryoidal deposit forming on glacier ice, on stones, and ledges in the higher Alps during cool, clear nights leading to mornings with sunrise temperatures of 2° or 3°C. Hellman[3] seemed inclined to group the deposit described by Ratzel under a kind of "frostbeschlag."

[1] French "verglas de neige"; American "snow-formed glaze."—C. A. jr.
[2] Letter from *Ratzel* to the "Briefkasten" in Das Wetter, Braunschweig, 1899, **6**: 216.
[3] *Hellman:* Classification of the hydrometeors. MONTHLY WEATHER REVIEW, July, 1916, **44** : 386, column 2.

FROZEN DEW.

The director of the Chilean Meteorological Service, W. Knoche, described in 1911 a phenomenon of Chile not altogether unrelated to these two forms. He remarks[4] that during June, July, and August (i. e., rainy season) the evening hours often bring a rapid rise in the relative humidity to a degree higher than 90 per cent, as a result of the rapid fall in temperature after sunset and particularly on days of cloudless skies. There results a very heavy desposition of dew which is converted into ice as the radiation of heat increases. This deposit of frozen dew (called "helada" at Santiago, Chile) still covers the ground at 9 a. m. to an extent that makes it quite possible to lose one's footing; it forms icicles as much as 1 cm. in length on exposed thermometers and has been known to contribute to the interruption of anemometers.—C. A. jr.

GREAT THUNDERSTORM OF AUGUST 1, 1917, IN TRINITY COUNTY, CAL.

The Weaverville, Cal., correspondent of the Humboldt Standard, Eureka, Cal., writes as follows in the issue for September 27, 1917:

WEAVERVILLE, CAL., *September 27, 1917.*

The first day of August will long be remembered by residents of a part of Trinity County as the day of the most severe electrical storm ever known here. Old-timers compare it with the terrible lightning of the Eastern States. The Forest Service, however, had the greatest occasion to remember this storm, as for almost the whole month one-half of its force was engaged in fighting the many fires resulting from this one storm. The fact that no rain accompanied the electrical display and that the entire country was in the most inflammable state known because of the great shortage in rainfall, explains the multitude of trees which took fire immediately on being struck. No one will ever know just how many fires were started, but 80 were reported. Undoubtedly not all the fires that ensued were seen. Lookout Hoffman, on Hayfork Bally, states that on Chapparal Mountain and on Eltapome Creek, on an area of approximately 5 miles square, the lightning struck 150 times. Although Mr. Hoffman has witnessed the fierce tropical storms in South America, he says that the Trinity County storm beats them all. Lookout Higgins, on Ironsides, says that to him the country looked like one vast Christmas tree as various trees blazed into light on being struck. From McDonald's home at Burnt ranch, which has a comparatively restricted view, eight fires were counted. From Willow Creek to the Lassic Peaks all observers unite in stating that from 7 to 12 o'clock the heavens were ablaze with one big light, so continuous and intense as to create the impression that the universe was being lighted by one all-powerful and wide-reaching electric light.

Mr. James Jones, Weather Bureau observer at Eureka, Cal., who has submitted the above clipping, writes that this was undoubtedly a remarkable thunderstorm.

Thunderstorms in this vicinity are rare, especially during the summer months, and those that do occur are usually of slight intensity and short duration.

This storm apparently covered an area at least 30 miles square and was active for at least five hours. It extended as far west as Eureka, where lightning was observed from 8 p. m. to midnight and where 0.02 inch of rain occurred between 11 p. m. and midnight. The lightning, as observed here, was the most prolonged and vivid within the recollection of any living man.

Coming, as this great storm did, after the driest Spring and Summer ever known in this section, it seems probable that the published reports of fire damage resulting from the lightning are not exaggerated.

The regions referred to in the article are comparatively inaccessible, and full details have just become available [Sept. 28, 1917], though every person coming out of the mountains since the first part of August has brought tales of the great "electric storm."

[4] *Knoche, W.* Glatteisbildung. Meteorol. Ztschr., Feb., 1911, **28** : 93.

HEAVIEST RAINFALL IN THE BRITISH ISLES.

The Scientific American for November 24, 1917 (p. 379), states that during a more or less general heavy rainstorm in southern England on the night of June 28, 1917, a rainfall measurement of 9.84 inches was recorded at Bruton, Somerset. This was the heaviest 24-hour rainfall ever recorded in the British Isles up to the time of writing.

The same paragraph states that the afternoon thunderstorm at Campden Hill, Kensington, London, on June 16, 1917, gave a fall of 4.65 inches in 24 hours (see the Monthly Weather Review, September, 1917, p. 453–4).

Reports for subsequent months, published in "Nature" (London), show that the Summer and Fall of 1917 were unusually rainy and stormy in the British Isles. Further interesting details will be given when the 1917 volume of "British Rainfall" is available.—C. A. jr.

INFLUENCE OF WEATHER CONDITIONS ON THE AMOUNTS OF NITROGEN ACIDS IN THE RAINFALL AND ATMOSPHERE IN AUSTRALIA.[1]

Prof. Orme Masson, Chairman.

During the period March 15, 1916, to March 31, 1916, daily samples of rain water collected at 16 stations suitably distributed over the continent of Australia have been quantitatively examined for nitric and nitrous nitrogen. Altogether about 1,000 samples have been examined. The results, when compared with the daily weather records and isobaric charts, confirm the following conclusions drawn from the results of experiments previously [1912–1914] conducted by V. G. Anderson at Canterbury, Victoria:[2]

(1) For a given type of weather *the concentration* of oxidized nitrogen in the rainfall varies inversely as the amount of rainfall.

(2) *The total amount* of oxidized nitrogen per unit area, found in the rainfall accompanying a storm, depends on the type of weather [Antarctic control, tropical control, divided control], and is practically independent of the amount of rainfall.

The work carried out during 1916 has also shown the following:

(3) Antarctic storms at different stations carry down amounts of oxidized nitrogen which do not differ greatly from the amounts previously found at Canterbury.

(4) Rain falling at northern stations [equatorward stations] during the prevalence of trade winds, contains amounts of oxidized nitrogen which are almost equal to the amounts found in the rain accompanying Antarctic depressions (rear isobars) at southern stations. This is shown to be probably due to the anticyclonic origin of winds accompanying both types of rain.

(5) Passage over land modifies anticyclonic air only to a slight extent; but if, during the passage, it is subjected to the influences accompanying monsoonal disturbances, comparatively large amounts of oxidized nitrogen are found in the subsequent rainfall.

(6) The highest total amounts of oxidized nitrogen are found at southern and inland stations in rain water resulting from monsoonal storms following a "heat wave."

(7) Rains occurring during "divided control" weather contain less oxidized nitrogen than tropical rains, but more than Antarctic rains.

(8) The nitrogen-fixing powers of inland monsoonal depressions tend toward the gradual enrichment, in respect of oxidized nitrogen, of the soil in southeastern Australia.

A number of determinations of the volume concentration of nitrogen peroxide in the atmosphere during the prevalence of anticyclonic weather has shown that at Canterbury, Victoria, in the rear circulation of anticyclones the air contains a greater proportion of nitrogen peroxide than the air of the front circulation.

On the assumption that the oxidized nitrogen of the rainfall is derived from the atmosphere, the amounts of nitrogen peroxide in the latter were compared with the amounts of oxidized nitrogen found in the rainfall at Canterbury for the corresponding weather types. It is shown that air containing 0.56 volume of nitrogen peroxide per 10^9 volumes in the rear of an anticyclone, would require to be washed out to a height of about 4,000 feet above ground-level in order to give the amount of oxidized nitrogen usually found in the rainfall accompanying this weather condition. Similarly, in the case of the front of an anticyclone, it is shown that the height would require to be about 3,100 feet. The above are in fair agreement with the average altitude of rain clouds (base), which according to leading authorities is about 3,500 feet.

[1] *Report of Committee, reprinted from* Report of the 86th Meeting of British Association for the Advancement of Science, Newcastle-on-Tyne, Sept. 5-9, 1916. London, 1917. 8°. pp. 128-129.

[2] *Anderson, V. G.* Abstract in Monthly Weather Review, July, 1915, 43 : 345-6. Published in full in Quart. jour., Roy. met'l soc., 1915, 41 : 99 and ffg.

LUNAR PERIOD IN THE RATES OF EVAPORATION AND RAINFALL.

By J. R. Sutton.

(Abstract of paper before the Royal Society of South Africa, Cape Town, Aug. 15, 1917.)

[*Reprinted from* Nature, London, Oct. 25, 1917, 100 : 160.]

The paper directs attention to the possibility of a lunar influence governing the evaporation from a water surface, and a lunar period in the incidence of rainfall. Tables are given showing that as the result of hourly observations of evaporation and rainfall during the 120 lunar months from August, 1899, to April, 1909, rainfall has its maximum frequency about the time of moonrise and its minimum just after moonset; also that the rate of evaporation has a maximum and minimum, respectively, shortly after the moon passes the meridian above and below the horizon.

The reader will find an adequate discussion of lunar influences on determining meteorological elements in this Review, April, 1915, pp. 179–181.—C. A. jr.

John West James, 1838-1917.

The following note is reprinted from Climatological Data for Illinois, October, 1917:

Mr. John West James, cooperative observer at Riley, McHenry County, Ill. (P. O. Marengo), died October 31, 1917, at the age of 79. Mr. James came to Illinois from New York in 1860. He began his work as voluntary observer for the Government in October of that year, and continued almost without interruption until the time of his last illness, thus completing a gratuitous service of 57 years, the longest record made by any cooperative observer in Illinois, and, no doubt, one of the longest in the United States. This entire record was made on the same farm. Mr. James was a close student of astronomy and meteorology, in both of which he was well versed. His reports were relied on as practically infallible, and the Weather Bureau has lost one of its most efficient and painstaking observers.—*C. J. Root, Section Director.*

SECTION III.—FORECASTS AND WARNINGS.

FORECASTS AND WARNINGS, OCTOBER, 1917.

By ALFRED J. HENRY, Supervising Forecaster.

[Dated: Weather Bureau, Washington, Nov. 17, 1917.]

INTRODUCTION.

Since the beginning of the forecast and warning service in the seventies it has been the rule, though not an invariable one, that this chapter in the MONTHLY WEATHER REVIEW—Forecasts and Warnings—shall be prepared by the official who was on active forecast duty during the month.

In all there have been about 20 different officials engaged at one time or another upon forecast duty. It needs no stretch of imagination to realize that 20 persons writing upon any subject without conscious effort to treat it systematically will produce as many divergent reports as there are writers. It has therefore seemed to the present writer that from the viewpoint of the forecasters themselves, the chapter in question should be prepared with a definite end in view and after a uniform plan. For example, it would seem desirable that the direct objects should be: (*a*) To form a concise account in narrative form of the forecasting activities of the bureau for the month; (*b*) to stimulate in forecasters and other officials a lively personal interest in that work; and, finally, (*c*) to acquaint educators and other persons with some of the details that are known only to forecasters themselves.

The plan.—Charts II and III, paths of anticyclones and cyclones, respectively, to serve as the basis of the discussion. Subordinate features appropriate for remarks are: (1) The pressure distribution in Alaska and the Pacific; (2) the character of the weather of the month as a result of cyclonic and anticyclonic control; (3) forecasts of the weather, and by weather is meant the occurrence or nonoccurrence of precipitation, changes in temperature above or below a certain limit, the direction and force of the winds, etc. These may be treated in a general paragraph or in detached paragraphs in connection with the cyclonic and anticyclonic control in each case; (4) warnings of all classes discussed with reference to the cyclonic or anticyclonic control.

WEATHER OF OCTOBER, 1917.

The weather of October, 1917, may be characterized as cold east of the Rocky Mountains with several periods of abnormally low temperature during which the earliest killing frost on record occurred at many places. West of the Rocky Mountains the temperature was somewhat above the seasonal average and very little precipitation occurred. In the Lakes Region, the Ohio Valley, and the Middle Atlantic and New England States, the low temperature was associated with much cloudiness and rain, a combination that resulted in disagreeable stormy weather in a month that is generally recognized as one of the most pleasant of the year.

PRESSURE OVER PACIFIC AND ALASKA.

Daily reports of pressure wind and weather are received by cable from two points in the Pacific, viz, Midway Island and Honolulu, Oahu. The pressure variations at these two placces during October, 1917, were only roughly synchronous and, indeed, at times they were opposite in phase. Midway pressures were uniformly higher than those of Honolulu and the amplitude of the variations was greater. Comparing Midway pressures with those of Dutch Harbor, Alaska, for example, the results for the month were mostly negative. It is evident that Alaska pressures should be classed as coastal and interior and that the distribution must frequently be opposite in phase over the two regions. From the 14th to the 22d, pressure was high in interior Alaska and to a lesser degree over the Canadian northwest and the east slope of the Rocky Mountains Region. During this time LOWS were passing eastward from the northeastern Rocky Mountains slope, followed closely by HIGHS, which moved rapidly southward over the Plains States. While the barometer fell at times along the Pacific Coast intense LOWS were wholly absent—see remarks of District Forecaster Willson, page 506.

HIGHS.

Origin of highs.—The HIGHS of the month originated, so far as can now be determined, probably over the Pacific Ocean immediately west of British Columbia, although the paucity of observations makes it impossible to fix, with any degree of accuracy, the actual origin of those HIGHS first observed in British Columbia and Alberta. This, however, seems clear: They did not originate in Alaska in October, 1917. Rather it would seem the appearance of a LOW in the vicinity of Sitka is a condition favorable to the early development of a HIGH in British Columbia or perhaps in Alberta. More observations and study of the problem is necessary before safe conclusions can be reached.

Eleven HIGHS have been plotted on Chart II (XLV-96). Among these numbers *II*, *IV*, *VI*, *VIII*, *X*, and *XI* are of special interest by reason of the strong southerly component in their movement. In general the direction of movement was east-southeast as may be seen by an inspection of Chart II; but the paths of those above mentioned both individually and collectively have a strong southerly component over the Plains States, coupled with an unusually rapid progression; in one case, that of No. *II*, the 24-hour movement (a. m. of 7th to a. m. of 8th) was about 900 miles, or at the rate of 38 miles per hour. This statement does not mean that the entire mass of air comprised within the crest of the HIGH advanced bodily southward at the rate of 38 miles per hour, but rather that the crest of the HIGH, which appeared on the morning of the 7th just north of Havre, Montana, appeared on the morning of the 8th at Dodge, Kans., about 900 miles to the southeastward. I prefer to believe that this transfer was brought about by some readjustment of the pressure of the atmosphere in the region between these two points. How such adjustment was brought about and at what level in the atmosphere it took place can not be definitely stated. Kite flights at Drexel, Nebr., indicate that the layer of cold air in front of a HIGH extends from 1 to 3 kilometers above the surface—rarely as high as 3 kilometers.

The forecasting significance of the movement or the readjustment, whichever it be considered, lies in the

changes in temperature involved. The change from relatively high to relatively low temperature was a physical phenomenon quite apparent to the senses whereas the change in pressure was probably not. Temperatures fell sharply in advance of the HIGH over a zone of irregular shape but extending at least 1,000 miles in a north-south direction. Some of the changes were:

Rapid City, S. Dak., from 42° to 24°.
North Platte, Nebr., from 42° to 24°.
Dodge City, Kans., from 54° to 28°.
Oklahoma, Okla., from 52° to 44°.
Dallas, Tex., from 68° to 54°.
San Antonio, Tex., from 70° to 66°.

The drop on the second day at San Antonio, Tex., was from 66° to 46° and for other points of southern Texas in proportion. A change to lower temperature may thus sweep southward at a speed of nearly 40 miles an hour. Similar changes were also experienced in connection with HIGHS *IV*, *VI*, *VIII* and *X;* the fall in connection with *VI* and *X* being more severe than in the others. Freezing temperature was recorded at San Antonio on the morning of the 30th, being the lowest October temperature of record there. The lowest October minimum temperature of record was quite generally observed on that date throughout Texas and Oklahoma, also in Arkansas, Missouri, and at Vicksburg, Miss.; the period of observations at the last named covering upward of half a century. A second significant fact in connection with the southward sweep of HIGHS was the absence of precipitation of consequence in the Plains States and the Southwest.

It is of particular interest to forecasters to note that the one of the meteorological condition favorable to a southward sweep of HIGHS over the Plains States is a trough of low pressure extending from, say, the upper Mississippi Valley to Texas. It will be seen from Chart III (XLV–97) that the centers of October LOWS moved far to the north of the Gulf States; however, each LOW was associated with a more or less pronounced trough that extended far to the southwest and some of them were of the V-type with the apex of the V extending into northeastern Colorado. Such pressure configurations are quite favorable to the southward advance of HIGHS and lower temperature. In one case, that of HIGH No. *IV*, the HIGH advanced eastward almost as rapidly as southward and to that fact was due the clearing of the weather in the Ohio Valley on the 13th while the center of the LOW was still over eastern Lake Huron.

The turning of HIGHS to the northeast after reaching the latitude of Oklahoma or north Texas is perhaps a natural consequence of the more rapid eastward drift in northern than in southern latitudes. When a trough of low pressure is passing eastward over the Plains States the northern end moves more rapidly than the southern, and as a result there is a tendency toward the formation of secondary centers of low pressure in the southern end of the trough. These are generally of little significance in forecasting except that they favor a direct southward sweep of the high rather than an eastward sweep. So it generally happens that HIGHS in the Missouri Valley often make a long detour to the south before turning to the northeast. How much of this movement is due to gravitational effect can not of course be easily evaluated but it must be considerable. The winds on the front of HIGHS moving southward over the Plains States are almost invariably fresh to strong and due north in direction. When the falling temperature and high winds are attended by snow the term "blizzard" is used to describe the resulting weather.

Northers in the Canal Zone.[1]—The conditions favorable to the development of a "Norther" over the western Gulf of Mexico and the western Caribbean were present on several occasions during the month, particularly on the 23d and again on the 30th, but it was not until November 3 that a "Norther" in full force was experienced in the Canal Zone. For this reason the track of the HIGH which produced it, No. *XI* of Chart II, is of special interest. While the warnings were issued in November the HIGH had its origin over the northern part of the Great Basin on the 30th. On that date pressure was 30.30 inches and slightly over throughout the Great Basin. Pressure fell slightly on the afternoon of that date and rose somewhat on the 31st. Then began a slow movement to the southeast which brought the crest of the HIGH to the northern part of the East Gulf States by the morning of November 3 with a gradient for northerly winds over the Gulf of Mexico, the Caribbean Sea, and the Greater Antilles, and an increase in central pressure from 30.40 to 30.60 inches. The increase in central pressure, as above, seems to indicate strong nocturnal radiation within the HIGH.

Subsequent mail reports show that there were strong winds over the western Gulf of Mexico on the dates following the warnings for Northers. On October 23, 1917, the steamer *Olympic* was wrecked about 60 miles off Frontera, Mexico, in a strong northerly gale and heavy sea. The morning report of October 30 from Vera Cruz gives a wind velocity of 38 miles per hour from the northwest.

LOWS.

The paths of eleven LOWS have been platted on Chart III and one which moved from the upper Lakes to the mouth of the St. Lawrence during the first few days of the month was platted on the September chart. The LOWS may be classed according to place of origin as follows:

Alberta, 7; Northern Rocky Mountain, 2; Middle Rocky Mountain, 1; and Atlantic, south of the Carolina coast, 1.

The majority of these LOWS passed eastward or northeastward without developing unusual features.

The two Northern Rocky Mountain LOWS, *VII* and *X* of Chart III, were attended by high temperature and quite general thundershowers east of the Mississippi. The temperature fell sharply in the rear of both these LOWS. The contrasts in weather on the two sides of the LOW were striking, viz, thundershowers and warm weather on the east and snow with low temperature on the west.

As Alberta LOW No. *VIII* reached the upper Lakes Region, pressure began to rise at the center and a strong anticyclone appeared in its rear, with steep gradients for northerly winds over the Dakotas. As the center passed across the Great Lakes the central pressure continued to rise and the expected steep gradients for northwesterly winds did not materialize over the Lakes, although northwest gales were experienced in the upper Mississippi and lower Missouri Valleys. When the center of the LOW had reached the upper Ohio Valley with a central pressure of 30.10 inches, on the morning of the 23d, the disintegration of the LOW seemed imminent. On the afternoon of the 23d, however, pressure fell rapidly over the Middle Atlantic States, with a maximum fall over southeastern Virginia, and on the 8 p. m. map of that date a depression of 29.90 inches appeared in that region. This depression developed into a severe storm of wind and rain during the

[1] Northers on the Texas and Gulf coasts are discussed in this REVIEW, 1893, 21: 226, 332, 363, and 1898, 26: 446.

next 12 hours, and moved northward on the 24th, passing down the St. Lawrence Valley on the 25th (see *VIII* of Chart III).

The second Northern Rocky Mountain LOW, *X* of Chart III, appeared in northwestern Montana on the morning of the 27th; reached the Great Lakes by way of Wyoming, Colorado, Kansas, Missouri, and Iowa two days later; passed down the St. Lawrence Valley on the 30th; and caused moderate to fresh southerly shifting to westerly gales along the Atlantic Coast north of the Carolinas on the 30th.

WARNINGS.

Frost.—Warnings of frost or freezing temperature were issued for one part or another of the Washington forecast district on 11 days in October, 1917.

The lateness of the Spring of 1917 caused much speculation as to whether or not an early autumn would be experienced. The record of the month leaves no uncertainty as to the fact that killing frost and freezing temperatures occurred much earlier than usual in many parts of the country.

Gales.—The month was unusually stormy, particularly on the Great Lakes and on the Atlantic Coast north of the Virginia Capes. Warnings of strong winds to moderate gales on the Great Lakes were ordered on 15 dates. Not all of the storms were severe, nor did they attain equal intensity on all the lakes. Storms were more frequent on Lake Superior than on the remaining lakes, and the storm of October 25–26 did not reach the Upper Lakes. Warnings were issued for Atlantic Coast stations on 10 dates. The display on the four days, October 9, 10, 11, and 12, was for a coast storm that at no time until the 11th approached close to shore. The steamship *New Orleans* encountered this storm off the Virginia Capes. She had an accident to the 20-inch suction pipe connected to the condenser and before repairs could be made foundered and sank.

The storms of October 24–25 and 29–30 were the most severe of the month, both causing considerable loss to beach property along the Middle Atlantic and New England Coast.

Reports of the forecasting activities at forecast districts outside of Washington, D. C., follow.

WARNINGS FROM OTHER DISTRICTS.

Chicago (Ill.) forecast district.—October, 1917, was characterized by remarkable activity in the development and movement of disturbances from the Northwest. The total number for the month, with a 12-hour pressure fall exceeding 0.33 inch, was 13, mostly of the Alberta type. The average greatest 12-hour pressure fall for the 13 storms was 0.49 inch. This unprecedented activity was in striking contrast with the conditions which obtained during October in the years 1900–1916, inclusive, during which time there was a total of 59 storms from the far Northwest, or an average of $3\frac{1}{2}$ per month, with greatest 12-hour pressure fall exceeding 0.33 inch. The greatest number for any previous October was 6, and in 1900 there was none. Not only was the number of these disturbances large and their rate of movement much in excess of the average, but several of them moved far south of the normal path for storms of the Alberta type, crossing Minnesota and Wisconsin and causing much stormy weather in those States as well as in northern Illinois and eastern Iowa.

Except in the northern Rocky Mountains Region the mean temperature for October was much below normal in this forecast district, and was the lowest for that month at practically every station. At Duluth the record mean temperature was lowered by 7 degrees.

Frost warnings were issued for Minnesota and portions of the Dakotas on October 4; for the upper Mississippi Valley and western Lake region on the 5th; for western South Dakota on the 6th; for the middle and northern portions of the district on the 7th; for Illinois and portions of Missouri and Wisconsin on the 8th and 10th; for northwestern Missouri, southeastern Wyoming, and Kansas on the 11th; and warnings of freezing temperature for Illinois on the 12th. These warnings were well verified, as a rule, and by the 13th killing frost had occurred over the entire district.

On the morning of the 21st a disturbance was centered over North Dakota with a secondary disturbance apparently developing over eastern Colorado, while a marked rise in pressure with a corresponding temperature fall was shown at Edmonton and Calgary, Alberta. These conditions being quite favorable for the building up and rapid southeastward advance of a high-pressure area, attended by much colder weather over the northeastern slope of the Rockies, cold-wave warnings were issued for Montana east of the Divide, northeastern Wyoming, and the extreme western portions of the Dakotas. The afternoon map of the same date showed a well-developed high-pressure area over Alberta and a secondary depression over eastern Colorado, and cold-wave warnings were extended to cover the remainder of the Dakotas and Wyoming, Nebraska, western and central Kansas, northwestern Minnesota, and western Iowa. On the following morning warnings were issued for southern Iowa, northern and western Missouri and Kansas. These warnings were fully verified at some stations and partially at others as far east as the Missouri River.

A disturbance which developed over eastern Washington during the night of the 26th–27th moved rapidly southeastward to Colorado, thence eastward to southwestern Missouri, where it was central on the evening of the 28th. Following this disturbance an area of high pressure of great magnitude built up over Alberta and advanced rapidly southeastward over the Rocky Mountains Region. It was attended by a cold wave, severe for the season, in the Rocky Mountains Region and from the southern Plains States eastward, temperatures of 0° F. and below being reported in Wyoming on the 29th. Warnings were issued well in advance of the cold wave for practically the entire region affected.—*Chas. L. Mitchell, Assistant Forecaster.*

New Orleans, La., forecast district.—An exceptionally large number of severe frosts and cold waves occurred in this district during October, 1917. The cold waves in this district during October of this year exceeded the total number that have occurred here in that month during the past 15 years. Warnings for unseasonably severe weather conditions were issued on four dates.

The weather conditions as shown by the 8 a. m. map of October 8 indicated warnings for frosts in this district, 10 days to two weeks earlier in the season than such general frosts had previously occurred.

Frost warnings were issued as follows: On Monday, October 8, for Tuesday morning, for Louisiana (interior); for Arkansas, south, heavy frost north, and freezing northwest; for Oklahoma, freezing; for western Texas, frost, except southwestern portion; for eastern Texas, frost interior.

Special frost warnings was issued on Monday morning, October 8: Louisiana, northern portion of the sugar and trucking region Wednesday morning.

Freezing or heavy to killing frost prevailed over Oklahoma and Arkansas; and frost occurred nearly to the Gulf coast, being heavy over the northern portions of Louisiana and Texas Tuesday morning, October 9.

On Wednesday morning, October 10, heavy to killing frost occurred over the interior of Louisiana; minimum temperatures ranged from 25° over the interior to 40° near the coast, with frost well southward into the sugar and trucking region.

The warnings for these unprecedented frosts were issued 24 to 48 hours in advance. The value of food crops gathered and saved as a result of these warnings was large; there were, however, large crops over the northern portion of the district which could not be protected, such as rice and cotton, and the injury to these crops amounted to several millions of dollars.

The weather conditions as shown by the 8 p. m. map of October 17 and the 8 a. m. map of the 18th, indicated warnings for an exceptionally severe cold wave for the season and heavy frosts. Warnings were issued as follows:

Wednesday, October 17 (p. m.): For Oklahoma and the Texas Panhandle, cold wave; the temperature will be below freezing in Oklahoma and 20° to 26° in the Texas Panhandle Friday morning.

Thursday, October 18 (a. m.): For Louisiana, freezing in north portion and frost in the sugar and trucking region by Saturday morning; for Arkansas, cold wave and freezing in northwest portion; for Oklahoma, cold wave with temperature below freezing; for northern portion of West Texas temperature will be below freezing; for East Texas, freezing northwest and north-central portions Friday morning.

Friday, October 19 (a. m.): For Louisiana, heavy frost nearly to coast; for Arkansas, heavy to killing frost; for East Texas, frost nearly to the coast.

The cold wave and freezing temperatures occurred Friday morning as forecast. Heavy to killing frost occurred Saturday morning in Arkansas, heavy frost in Louisiana nearly to the coast, with the temperature 32° to 36° in the sugar and trucking region, and light to heavy frost in the interior of Texas.

Warnings were issued on the morning of October 21: For Arkansas, heavy frost; for Louisiana, frost nearly to coast, heavy in the interior; for eastern Texas, heavy frost in north and frost in southern portion nearly to the coast, except in the lower Rio Grande Valley.

Frost occurred on the morning of the 22d as forecast.

The weather map of October 22 indicated the severest weather conditions for the season that had occurred so early in the season in several years. As seed cane had not been put down, freezing weather warnings were issued, and extended 48 hours in advance for the sugar and trucking regions, as follows:

Monday, October 22 (a. m.): For Oklahoma, cold wave with temperature 22° to 26° Tuesday morning; for Arkansas, cold wave at Bentonville; for eastern Texas and Louisiana, freezing in the northern portion of the sugar and trucking regions Wednesday morning; seed cane should be put down.

Cold-wave warnings were issued at night for Shreveport, Palestine, Dallas, Fort Worth, Taylor, and Abilene.

Tuesday, October 23 (a. m.): For Wednesday morning—Arkansas, freezing; Louisiana, frost to coast, freezing in the interior with temperatures of 29° to 32° in the northern portion of the sugar and trucking region; for eastern Texas, frost to coast, except in lower Rio Grande Valley; freezing in the interior, with temperature 30° in the northern portion of the sugar and trucking region; cold wave at Houston and Port Arthur.

The cold wave occurred on the morning of the 23d in Oklahoma and northwestern Arkansas, and the temperature fell about 20 degrees over the interior of Texas and Louisiana, and the cold-wave warnings were partially verified. On Wednesday morning, the 24th, freezing temperatures prevailed southward nearly to the Gulf coast, with the temperature 27° to 35° in the northern portion of the sugar and trucking regions of Louisiana and Texas.

If the warnings had not been issued 48 hours in advance of this freeze, and sugar planters advised to put down seed cane, many planters would have been without seed cane for planting next year's crop, and the sugar output would have been materially reduced. No such low temperatures had occurred in the sugar and trucking regions as early in the season in previous years, and this warning with its advice proved an important factor in the conservation of an important food product for the coming year.

The 8 a. m. weather map of October 28 indicated severe weather conditions for this district, and warnings were issued for agricultural and live-stock interests, as follows:

Sunday, October 28 (a. m.).—For Oklahoma: Snow to-night or Monday; cold wave; temperature will be 26° to 30° Monday morning; strong northwest winds. For the northern portion of western Texas, probably snow; cold wave; temperature will be 24° to 28° Monday morning. For the northwestern portion of eastern Texas, cold wave at Abilene; freezing Monday morning.

Cold-wave warnings were extended, on the 8 p. m. map, over Arkansas, eastern Texas to the coast, and northern Louisiana, and warnings for freezing in the sugar and trucking region of Texas and Louisiana on Tuesday morning.

Snow fell in Oklahoma and the northern portion of west Texas, and the cold waves forecast for Monday morning occurred.

The 8 a. m. weather map of Monday, October 29, indicated that the lowest recorded October temperatures would occur in this district. Cold-wave warnings were extended to the coast, and the following warnings for unprecedented low temperatures for the season, to occur on Tuesday morning, October 30, were given the widest possible distribution.

Oklahoma: Temperature will be 10° to 18°.

Arkansas: Temperature will be 18° to 24° in the northern and 24° to 26° in the southern portion.

Eastern Texas: Temperature will be 24° to 30° in northern portion; cold wave in southern portion, except on west coast, with temperature 28° to 32° in sugar and trucking region.

Louisiana: Cold wave; temperature will be 24° to 30° in northern portion, 27° to 32° in the sugar and trucking region, and 38° to 44° at New Orleans.

On account of the large acreage of sugar cane standing and subject to severe injury from such temperatures, of Irish and sweet potatoes and other matured crops in the fields at this season of the year, and because growers previously had not experienced such low temperatures as these forecasts called for, the warnings for Louisiana and eastern Texas were supplemented by the following special admonition:

"Vegetation should be protected and matured crops housed."

Temperatures on Tuesday morning, the lowest of record for October over the greater portion of the Louisiana district, were: Oklahoma, 14° to 18°; Arkansas, 22° to 26°; eastern Texas, 20° to 29° over the interior, 27° to 32° in the sugar and trucking region, and 40° to 41° along the coast line; Louisiana, 26° to 30° over the interior, 28° to 32° in the sugar and trucking region, and 40° at New Orleans.

The weather map for Tuesday morning, October 30, indicated that conditions would favor intense radiation in the sugar and trucking region Tuesday night, and warnings were repeated for Louisiana, advising that the temperature would be 26° to 30° in the sugar and truck-

ing region Wednesday morning, with the special admonition, "Continue protection of crops." The temperature in the sugar and trucking region of Louisiana Wednesday morning was 24° to 32°, being generally about 27°.

The windrowing of cane was pushed, and notwithstanding that the injury to the crop will reduce the output of sugar nearly one-fourth, the warnings enabled planters to take action which prevented the loss of half the crop. Thus the warnings enabled the saving of one-fourth the entire crop, and as the crop of 1916 was worth $36,642,240, this shows that the value of the sugar crop saved by these warnings will amount to several million dollars. Nearly half the Irish and sweet potato crops and many of the smaller matured vegetable crops were saved as a result of the warnings given. The great saving of food supplies as a direct result of the advices given by the Weather Bureau in this instance can hardly be estimated.

Weather warnings were issued for rice and alfalfa interests for 84 hours in advance on October 3, 4, 5, 9, 10, 11, 16; and for 60 hours in advance on the 2d, 6th, 8th, 12th, 13th, 15th, 19th, 31st. All these warnings were verified.

Fire-weather warnings were issued on the 22d and 28th; weather and winds occurred as forecast.—*I. M. Cline, District Forecaster.*

Denver forecast district.—The weather was exceptionally dry, except in north-central Colorado, where frequent rain or snow fell. Several regular observing stations in the district reported no appreciable precipitation. The month was marked by extremes of temperature, a severe cold wave occurring on October 29, with temperature readings in Colorado lower than ever before recorded in that State in October; hot weather prevailed in southwestern Arizona on the 5th and 6th, when the highest temperatures of record at Phoenix for those dates, 104°, was reached.

Frost warnings were issued for considerable areas in Colorado and New Mexico on the 7th, 8th, 9th, 11th, 13th, and 14th, and were generally fully verified.

Fire-weather warnings were issued on several dates and were verified in localities, notably on the 17th, when the fire-weather station on the western slope in Colorado reported a 24-hour wind movement of 800 miles.

Warnings of freezing temperature or killing frost were issued for Colorado, Utah, northern New Mexico, and northern Arizona on the morning of the 17th. The warnings were fully verified. Similar warnings were repeated for the same area the following morning and extended to include southeast New Mexico. Freezing temperatures again occurred and killing frosts were reported at Salt Lake City, Santa Fe, and as far south as Roswell, N. Mex. The temperature fell to 28° in eastern New Mexico and was much lower in northwest New Mexico.

Another anticyclone having overspread the northern Rocky Mountain region on the morning of the 20th, freezing temperatures were predicted for Colorado. Freezing temperatures occurred in the early part of the night. On the morning of the 21st warnings of decidedly colder weather, with temperatures considerably below the freezing point, were issued for north-central Colorado. By the evening of the 21st an anticyclone was spreading southward over Montana, and cold-wave warnings were issued for eastern Colorado. At this time temperatures were well above 60°. On the 22d temperatures were 20 to 30 degrees lower in eastern Colorado and considerably below the freezing point by night. On the morning of the 22d freezing-temperature warnings were extended to cover eastern New Mexico, and were verified.

A cyclone of marked intensity appeared over western Montana at 6 a. m. on the 27th and moved southeastward to Idaho by the evening of the 27th, when an anticyclone covered Alberta. Cold-wave warnings were issued on the evening of the 27th for eastern Colorado, with advices of decidedly colder weather. At 6 a. m. Sunday morning, the 28th, cold-wave warnings were extended to western and southern Colorado, northeast Arizona, and southwest Utah, with the advice that decidedly colder weather was indicated. Notice of much colder weather was also sent to Salt Lake City. The warnings were timely, as decidedly colder weather overspread the greater part of the district. In a large part of Colorado the temperatures on the morning of October 29 were lower than ever before recorded in Colorado in October. As a result of the warnings of the 27th and 28th, apple picking was rushed and picked fruit, potatoes, etc., that had been dug and were exposed in the fields were placed in storage or gathered in piles in the fields and covered. Some were lost, however, on account of the scarcity of labor and it is estimated that 5 per cent of the potato crop was frozen in the ground. Fortunately, by far the greater portions of the fruit and potato crops had been gathered before the freeze. At 6 p. m. of the 28th cold-wave warnings were extended to include eastern New Mexico. The following morning temperatures were much lower in New Mexico, but were still several degrees above the previous low-temperature records in that region.—*Frederick W. Brist, Assistant Forecaster.*

San Francisco forecast district.—The controlling features of the weather in this district during the month, were the frequent recurrence of high pressure areas over the Plateau and Rocky Mountain regions and the persistency off the north Pacific coast of the Pacific Ocean permanent HIGH. This distribution of pressure caused the depressions from the north Pacific to pass eastward at a high latitude. The result was but little precipitation west of the Rocky Mountains and south of the international boundary, nearly all of it being confined to the western portion of Washington. The month was one of the driest Octobers on record in the Pacific Coast States.

Southeast storm warnings were issued on the 1st, from the mouth of the Columbia River north. Small-craft warnings on the 8th for the Strait of Fuca. Northwest warnings on the 27th, at the Strait of Fuca and mouth of Columbia River with small craft warnings at other Washington stations; and southeast warnings at the Strait of Fuca with advisory at other northern stations except Marshfield on the 28th. The warnings were but partly verified as the storms moved inland at a higher latitude than was expected.

Warnings of heavy to killing frosts were issued on the 16th, 17th, and 18th for Washington, Oregon, and Idaho, and killing frosts occurred except near the coast.

Fire-weather warnings were issued in California on the 3d, 17th, and 25th, and were justified.—*G. H. Willson, District Forecaster.*

TROPICAL HURRICANE OF SEPTEMBER 27-28, 1917, IN SOUTHEASTERN LOUISIANA.

By RAY A. DYKE, Assistant Forecaster.

[Dated: Weather Bureau Office, New Orleans, La., Oct. 13, 1917.]

The tropical storm that occurred during the last week of September, 1917, was of more than ordinary extent and severity, as appeared when the western segment of the hurricane passed over extreme southeastern Louisiana on the 28th.

WARNINGS.

Ample notice of the presence of the storm was given in advisory messages, beginning on the 22d. On the 25th we were notified that hurricane warnings were hoisted from Apalachicola to Mobile and that all places on the coast from Mobile to New Orleans were advised to take all necessary precautions. These messages were radiographed to vessels at sea and all interests affected were kept fully advised.

Storm warnings were ordered for the Louisiana coast on September 26, as follows:

Hoist northeast storm warning 4:30 p. m., Burrwood, Empire, Pilottown, and Morgan City, La., for shipping and fishing interests. Tropical disturbance in middle east Gulf will cause increasing northeast winds.

(Signed) DYKE.

The following message was received at 9:30 p. m. on the 26th:

Hoist hurricane warning 10 p. m., Pascagoula to New Orleans. Single radio report to-night from east-central Gulf indicates some possibility that the tropical storm may approach the coast a little farther west than appeared probable Tuesday, beginning some time Thursday morning. Impossible to locate center of disturbance and hurricane warnings therefore now displayed from New Orleans to Apalachicola.

(Signed) FRANKENFIELD.

This warning was immediately transmitted to our storm-warning displaymen, with instructions to distribute thoroughly; and was disseminated by motor boat throughout the Barataria Bay section and to Grand Isle. The city police and fire departments assisted in the distribution of the warning in New Orleans and the daily papers gave the warning prominence. All persons were advised to take precautions against dangerous winds and high tides.

The following warning received on the morning of the 27th, was given the fullest possible distribution:

Hoist hurricane warnings along central and eastern Louisiana coasts beyond New Orleans, also inland storm warnings for southeast Louisiana. Disturbance this morning apparently central about 150 miles southeast of the mouth of the Mississippi River, moving north-northwest.

(Signed) FRANKENFIELD.

This warning was sent to all telephone exchanges in southeastern Louisiana, and Superintendent T. B. Baird of the Cumberland Telephone & Telegraph Co. instructed managers to give the warning the widest possible distribution. Both the Western Union and the Postal Telegraph companies and the Louisville & Nashville Railroad Co. had the warning telegraphed to their offices along the middle Gulf coast, instructing their agents to notify persons in exposed places to seek secure locations, and to warn oyster and fishing interests to keep their fleets in off the Gulf. Complete distribution was effected at and in the vicinity of New Orleans.

A message from the supervising forecaster at 9 p. m. of the 27th stated that it appeared probable that the storm would reach the Louisiana coast Friday morning, the 28th. This prediction was in accord with the hurricane warnings and was given appropriate distribution.

The Weather Bureau office was open to the public during the night of the 27th–28th.

In order that precautions in southeastern Louisiana on the 28th might not be relaxed until danger from the storm was definitely past, the following warning was issued:

Advisory warning, Louisiana coast, 8:30 a. m.: Tropical disturbance central at mouth of Mississippi River, apparently short distance southeast of Pilottown. Northerly gales, probably reaching hurricane force in southeastern Louisiana, with high tides to-day and to-night. Strong northwest winds on western Louisiana coast.

(Signed) DYKE.

In the distribution of this warning, particular attention was given to exposed places along and east of the Mississippi River.

The New Orleans Item, of September 28, 1917, comments as follows on the distribution of the warnings:

Whatever damage this gale may ultimately do, wherever it passes, will be largely unavoidable. Nobody in Louisiana or Mississippi is going to be caught unawares who can be reached by ordinary means of communication and by the extraordinary measures adopted by the Weather Bureau and by other public and private agencies to inform outlying places and persons.

The Weather Service has further commended itself to the people of the Gulf South in its ample warnings against the approaching disturbance. In view of the fact that Gulfport reports a gale of 50 miles * * * nobody along the eastern and middle Gulf coast will have the hardihood to find fault with hurricane warnings there because these warnings were not followed by the hurricane itself. * * *

Dr. Cline and his assistants have been the center of a disturbance all their own during the past few days, the locus of it being definitely established in the Federal building on Camp Street. Their department is rendering the country and its shipping great service in this as in similar visitations. Their service becomes more valuable as the department's facilities are extended in the Indies and the Caribbean.

METEOROLOGICAL CONDITIONS AND EFFECTS OF THE HURRICANE.

At New Orleans the pressure fell gradually during September 27, 29.77 inches being recorded at 7 p. m. The wind was northeast except for a few hours near noon, when it was east and southeast. The velocity increased from gentle to moderate. Lower clouds predominated, moving from the east and northeast; but 1/10 cirro-stratus from the southwest, was observed in the early morning. The sky was overcast in the afternoon, and rain from 1:22 to 2:45 o'clock was attended by unusually dark clouds and a sharp fall in temperature.

The pressure was lowest between 3 a. m. and 3 p. m. on the 28th, varying slightly during this time, the minimum being 29.61 inches. The wind velocity did not exceed 30 miles an hour at New Orleans, notwithstanding that hurricane winds were blowing at the mouth of the Mississippi River from 2 a. m. to 9 a. m., and the barometer column descended to 28.91 inches at Port Eads, at 6:30 a. m. The wind direction at New Orleans changed from northeast to north at midday and to northwest at 3 p. m. and the velocity diminished in the afternoon.

The river, which was low, rose from 5.2 feet, on the 26th, to 6.6 feet, on the 28th, after which it fell to 4.1 feet, on the 30th. The tide at Grand Isle and Port Eads was 4 feet above normal.

In order to show the conditions when the center of the disturbance was nearest the Louisiana coast, reports from the Mississippi River passes have been combined with the daily weather map. That the path of the center was close to Port Eads is made apparent by the accompanying figure 1 showing barometric pressure and wind directions in Louisiana at 7 a. m., September 28. Figure 2 shows the location of places on the lower river.

East winds were observed at the mouth of the river until about 3 a. m., after which there was a gradual change to northeast. During the height of the storm the directions were northeast and north-northeast. In the early afternoon the wind became northwest.

At Port Eads the anemometer of the United States Engineers' office registered until 7:10 a. m. of the 28th, when the exposed part blew away, just after recording 84 miles an hour. Mr. O. O. Melancon, junior engineer,

on duty at Port Eads at the time, estimates that between 7 a. m. and 9 a. m. the velocity reached 90 to 100 miles an hour. The highest velocities at the special Weather Bureau station at Burrwood were recorded between 5 a. m. and 9 a. m., the maximum velocity for a 5-minute period being 80 miles an hour at 5:40–5:45 a. m. A velocity of 79 miles an hour was recorded at 8:10–8:15 a. m.

It is probable that hurricane winds did not occur much farther up the river than Fort St. Philip, although there was considerable damage to the rice, sugar, and orange crops farther north in Plaquemines Parish. The greatest damage to crops was on the eastern side of the river. The western side escaped with small loss. This hurricane was like its predecessors, in that, when it reached the land, the wind velocities near the rim of the western segment were much less than the barometric gradient would indicate.

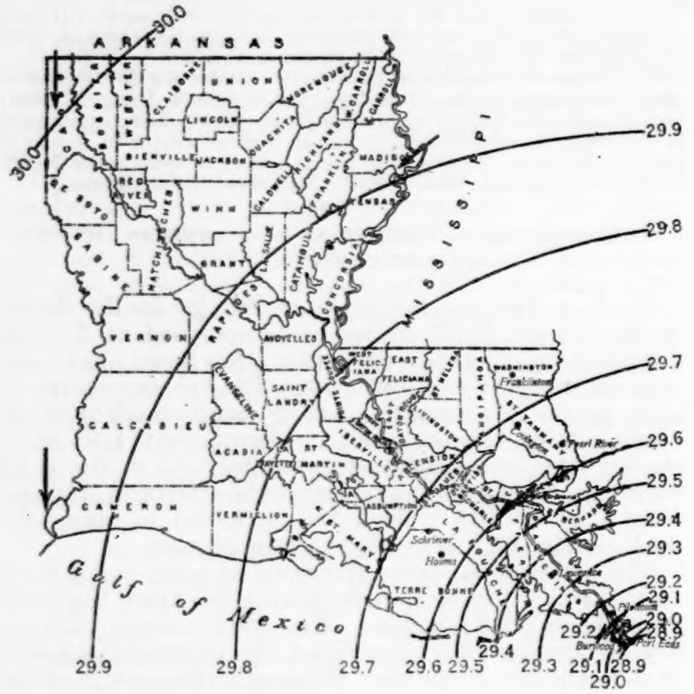

FIG. 1.—Map of Louisiana, showing isobars and a few wind directions at 7 a. m. September 28, 1917.

The precipitation was excessive only in the vicinity of the Passes and did not extend far inland. The fall at Burrwood on the 27th–28th was 6.40 inches.

Maj. Frank M. Kerr, of the Louisiana State Board of Engineers, reports that 3 miles of levees on the east bank south of Nicholls and 2½ miles between Boothville and Venice, on the west side, will require new earthwork and wood revetment as a result of the storm. The levees that were damaged on the eastern bank were struck by the Gulf waters from Breton Sound.

Below Buras numerous buildings were dislodged from their foundations, and several houses and barns were blown down. One building of considerable size was carried by wind and water through the levee and was left on the river bank. Fishermen along the lower river lost some of their small boats, but most of the boats were stranded and can be refloated. Fishing camps and the lodges of some hunting clubs suffered considerable damage. The western bank of the river was littered in places with the fragments of broken houses, and the bodies of dead animals, including cattle, horses, dogs, goats, and hogs, were seen along the lower river soon after the storm.

The early and thorough distribution of the warnings caused all kinds of craft to be placed in safe waters, and damage to shipping was exceedingly slight, other than that of the small boats already referred to. The bayous and canals provided a good refuge for boats.

In places subject to danger from high water along the Mississippi River and near Lakes Borgne and Pontchartrain people moved out, and there is no doubt that many lives were thus saved by the warnings. So far as can be learned the only loss of life was that of an 8-year old boy named James Ohenio, who, while walking along Bayou St. John, near New Orleans, was caught by a gust of wind, lost his footing, fell into the water, and died soon after being pulled out. This incident might have occurred with any strong wind.

FIG. .—Detail diagram showing relative locations of points on the lower stretch of the Mississippi.

Train service to Mobile was interrupted on the 28th and part of the 29th because of the washing out of the ballast under the Louisville & Nashville track near Lake Catherine, about 30 miles northeast of New Orleans. The movement of vessels toward east Gulf and Caribbean ports had ceased on the 24th. Sailings of vessels from New Orleans in all directions were cancelled on the 26th and 27th.

Early in the afternoon of the 28th we were able to announce that the storm had passed on the eastern side and that all danger in New Orleans was definitely over. Shipping was soon afterwards advised that it was safe to proceed.

SECTION IV.—RIVERS AND FLOODS.

RIVERS AND FLOODS, OCTOBER, 1917.

By ALFRED J. HENRY, Professor in Charge.

[Dated: River and Flood Division, Weather Bureau, Nov. 30, 1917.]

The rainfall of October, 1917, was light and infrequent except in the States from the lower Lakes Region eastward; even in those States flood stages were not reached until toward the end of the month, when two rainstorms within a week resulted in slight floods in the rivers of the Middle Atlantic and New England States. (Table 1.) The only other floods of the month were due to heavy rains which fell in Alabama during the closing days of September. Fortunately the rivers were at a low stage when the rains began, otherwise destructive floods would have resulted.

Property loss in watershed of Alabama River, October, 1917.

Tangible property, bridges, highways, etc.	Crops.	Suspension of business.	Money value of warnings.
$500	$10,000	$150	$6,000

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

TABLE 1.—*Flood stages in Atlantic coast drainage during October, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date.
		Feet.			*Feet.*	
Connecticut	White River Junction, Vt.	13	31	(†)	14.0	31
White	do	15			13.5	31
Mohawk	Tribes Hill, N. Y	16	31	(†)	20.2	31
Delaware (East Branch)	Fishs Eddy, N. Y	10	31	(†)	12.0	31
Delaware (West Branch)	Hales Eddy, N. Y	12	31	(†)	12.4	31
Lackawaxen	Honesdale, Pa	8	29	29	8.0	29
Susquehanna	Bainbridge, N. Y	11	30	(†)	13.2	31
Do	Wilkes-Barre, Pa	20			18.1	31
Neuse	Smithfield, N. C	13			11.9	31
Waccamaw	Conway, S. C	7			6.7	4
Black	Kingstree, S. C	12			10.9	6-7
Santee	Rimini, S. C	12	1	3	12.7	2
Edisto	Edisto, S. C	6			5.8	4

† Continued into November.

TABLE 2.—*Flood stages in various drainage areas other than the Atlantic coast drainage, during October, 1917.*

River.	Station.	Flood stage.	Above flood stages—dates.		Crest.	
			From—	To—	Stage.	Date.
East Gulf drainage:		*Feet.*			*Feet.*	
Alabama	Selma, Ala	35			34.0	2
Chattahoochee	Alaga, Ala	30			27.0	1
West Gulf drainage:						
Rio Grande	Rio Grande City, Tex.	15	(*)	2	21.7	1
Mississippi River (Ohio Basin):						
Allegheny	Olean, N. Y	12			10.9	30
Do	Warren, Pa	12	30	30	13.0	30
Great Lakes:						
Maumee	Fort Wayne, Ind	15	30	(†)	15.5	31

* Continued from September. † Continued into November.

ANNUAL RISE OF THE COLUMBIA RIVER, 1917.

By E. M. KEYSER, Observer.

[Dated: Weather Bureau Office, Portland, Oreg., Oct. 4, 1917.]

The summer rise of the Columbia River in 1917 demonstrated conclusively that unusually heavy snow coverings at the beginning of the spring season are not necessarily precursors of unusually high water. Between January 1 and March 17 the river stages at Portland, Oreg., varied irregularly between 0.7 and 6.7 feet. On this latter date the stage was 1.8 feet and from this time on the river, except for short temporary falls, continued more or less regularly to rise till May 15, when the flood stage, 15 feet, was reached. On June 22 the crest of the rise, 23.8 feet, passed Portland. From June 22 the water subsided quite regularly and on July 22, just one month after the passage of the crest, fell below the flood stage. This stage of 23.8 feet, although 2.6 feet above the 39-year average crest stage, has been exceeded nine times during the period of record.

While it is recognized that the annual rise is due largely to the accumulated snows in the upper levels of the watershed, the snow records are not available for the whole period of river observations. However, in extensive portions of the basin, fairly reliable records are available for at least 9 years, showing the depth of snow remaining at the close of the winter month..

Bulletins issued by the Oregon section show that at the close of winter the snow covering at practically all stations was not only above the average but was the greatest of record. In Washington every station in March reported the average or more remaining, and at the close of April every station reported more than the average remaining. In Idaho all drainage basins showed plus departures for snow covering at the beginning of spring. Likewise the Canadian reports showed excessive amounts of snow held over at the end of winter. Below will be found quotations from the Section Report of Oregon for March, 1917, concerning the snowfall in all sections of the Columbia River Basin in the mountains preceding the annual rise:

SUMMARY OF SEASON'S SNOWFALL.

At the end of March, 1917, the amount of snow within the Columbia River drainage area was much greater than at the same time a year ago. The total fall during the winter of 1916–17 was considerably less than the amount last season, but owing to cold weather in February and March, 1917, very little had melted, while last year those months were mild, and the snow at low levels had nearly all disappeared by the 1st of April. Should the temperatures during May be normal, or above the normal, unusually high water is almost certain to occur in the lower portion of the Columbia River next June. Much depends upon the manner in which the snow melts. When the spring months are cool, and the season is backward, we should expect higher water with the same amount of snow than when the season is early; therefore, as this year's season is backward and there is an unusual amount of snow in the mountains, caution should be exercised not to cultivate bottom lands that were overflowed last year, as present conditions indicate that we will have even higher water than that of 1916. * * *

Washington.—The snowfall of the past winter in the elevated regions, while above the normal, was not nearly so much as in the season of 1915–16. In December it averaged somewhat above normal; in January and February it was deficient at the lower levels of the eastern slope of the Cascades, but plentiful at the higher elevations. In March, especially during the last two weeks, the snowfall was phenomenal for the season, and the absence of warm winds and rain during February and March caused an accumulation of snow, so that the depth on March 31 was greater than in 1916, and almost unprecedented. There will doubtless be an abundance of water in the streams during the summer season.—*G. N. Salisbury, Meteorologist.*

Idaho.—The winter was the coldest of record, temperatures having been below normal for six consecutive months. The total snowfall was somewhat less than that of the preceding season, but previous records for heavy snowfall were exceeded in December and probably in March, and the snowfall in November, January, and February was above normal. Almost no melting has occurred in the mountains, hence the present snow supply is the greatest known at the close of March, being much greater even than that of the same date a year ago. Much ground that is ordinarily bare at this date is covered with from 1 to 2½ feet of snow. The snow was rather loose most of the winter, having fallen while the temperature was low, but most of it is now fairly solid. Many slides have occurred in the southern counties. A good flow of water may be expected during the season, and unusually high water is likely to occur with the first warm weather.—*Edward L. Wells, Meteorologist.*

Montana.—The snowfall for the season ending March 31 was one of the heaviest, if not the heaviest on record, over all the watersheds west of the Divide. The October snowfall was much greater than normal, the November and December amounts were in excess of the normal, the January snowfall was practically normal, and the amounts that fell during February and March were much greater than normal. Owing to the uniformly cold weather that has prevailed throughout the winter there has been less run-off than usual and the snow is not packed as hard as it would have been had there been thawing weather. At the end of March there had been very little thawing except in the lower valleys, and it is probably true that there is more snow in the mountains than there has been for the past 20 years. The density of the snow is less than it was a year ago, but due to the greater depths the resulting water will be greater. A heavy flow of water is early expected in all streams, and with a normal rainfall during the coming season an abundant water supply for all purposes is assured.—*F. L. Disterdick, Acting Section Director.*

Wyoming.—Snow layer at the close of March in the Snake River drainage of Wyoming was the deepest of record. Five stations had an average depth of 50 inches; last year the same stations averaged 27 inches, two years ago 11 inches, and in 1912 45 inches. A sample of snow taken at Alta 36 inches deep, the least reported, showed 28 per cent moisture. At Bechler River the snow was 7 feet deep, which is the greatest reported, although it is believed adjacent regions carry from 10 to 11 feet, solidly packed. There has been no appreciable melting of the snow up to the persent time.—*J. C. Alter, Meteorologist.*

British Columbia.—The snowfall again this year has been very heavy, particularly at Glacier; the season has been abnormally cold, and the climatic conditions at the close of March in the B. C. Columbia River district were nearly a month later than the average. Abnormally high temperatures now may cause floods this spring. At Rossland the snow on the mountains was 6 to 8 feet, with streams abnormally low, and should present mild weather continue the water will rise rapidly; at Cranbrook the streams are normal and the snow about 7 feet deep, but do not expect very high water; at Grand Forks, snow on the mountains still very deep, and on account of the extremely late season the streams are expected to reach higher levels than usual; at Golden snowfall below average, but the streams are icebound and with late breaking up abnormal water may be expected; at Revelstoke snowfall has been exceptionally heavy and is over 12 feet, and spring has hardly started. A sudden hot spell or warm rains would cause very high water.—*F. Napier Denison, Supt. Dominion Meteorological Service.*

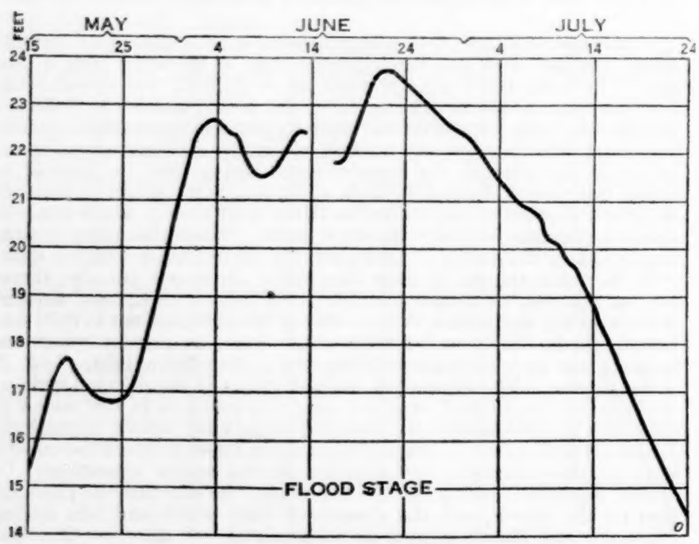

FIG. 1.—Hydrogram of the annual rise in the Columbia River in 1917, as shown at Portland, Oreg., by the flood stages between May 15 and July 22, 1917.

The 1917 rise of the trunk stream is shown graphically for Portland in figure 1 during the time the water was above the flood stage. The accompanying Table 1 shows for each station on the Columbia River the following data: Flood stage, dates of reaching and falling below flood stage, and date and height of crest stage. An examination of this table reveals the fact that the flood stage was not reached at more than half of the river stations. It was not reached in the Snake River at all, although the highest water at these stations passed fully three weeks before the crest in the trunk stream. At three of the seven stations on the trunk stream the flood stage was not reached—viz, Umatilla, Celilo, and Cascade Locks.

TABLE 1.—*High water during annual rise of the Columbia River, 1917 (tributaries and stations arranged downstream).*

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
Kootenai:	*Feet.*			*Feet.*	
Bonners Ferry, Idaho	26.0	June 19	June 19	26.0	June 19.
Pend Oreille:					
Newport, Wash	16.0	May 28	July 13	21.6	June 25.
Clearwater:					
Kamiah, Idaho	14.0	June 16	June 21	15.4	June 17.
Snake:					
Weiser, Idaho	14.0	....	....	11.9	May 28–29.
Lewiston, Idaho	22.0	....	....	18.2	May 30.
Santiam:					
Jefferson, Oreg	10.0	....	....	7.8	Apr. 8.
Yamhill:					
McMinnville, Oreg	35.0	....	....	22.3	Mar. 25.
Clackamas:					
Cazadero, Oreg	12.0	....	....	6.6	June 9.
Willamette:					
Eugene, Oreg	10.0	Apr. 8	Apr. 8	10.5	Apr. 8.
Albany, Oreg	20.0	Mar. 25	Apr. 27	13.4	Apr. 9.
Salem, Oreg	20.0	....	....	12.5	Mar. 30.
Oregon City, Oreg	10.0	....	....	9.4	Mar. 30.
Portland, Oreg	15.0	May 15	July 22	23.8	June 22.
Columbia:					
Marcus, Wash	24.0	May 26	July 28	30.0	June 23–25.
Wenatchee, Wash	40.0	June 18	June 29	40.4	June 20, 21, 24
Umatilla, Oreg	25.0	....	....	23.7	June 19.
Celilo, Oreg	30.0	....	....	20.8	June 19.
The Dalles, Oreg	40.0	June 20	June 21	40.4	June 20.
Cascade Locks, Oreg	46.0	....	....	32.5	June 20.
Vancouver, Wash	15.0	May 15	July 23	24.5	June 22.

Notwithstanding the presence of the immense reservoir of snow at the water heads and its potentiality to give perhaps a record flood, the height of 23.8 feet has been exceeded twice in the last nine years—viz, 1913 and 1916. This great volume of melted snow was carried out to sea with a large portion of the public being scarcely aware that the annual rise was in progress.

In seeking an explanation for this rather unexpected outcome from the great snow mass, the reason is found, perhaps entirely, in the extreme low temperatures prevailing over the watersheds of the Columbia system during the spring and early summer. The backward spring in the Pacific Northwest permitted a moderate rate of melting. The river reached flood stage at Portland six days before the 39-year average date and continued above the flood stage 69 days, or 26 days longer than the average flood-stage duration. Had the melting of this vast snow covering been rapid and the water been carried off in the average period of 43 days or less, it can readily be surmised that immense damage and general public inconvenience would have resulted.

Regarding these low temperatures, an examination of the records over the entire watershed show that with a few isolated exceptions there were no plus departures shown during the first six months of 1917. Not until July, after the passage of the crest into the ocean, did the monthly mean temperatures reach and pass above the

normal. In January there were places as much as 10 degrees below normal, in February and March as much as 9 degrees below, in April and May as much as 6 degrees, and in June 3 degrees below the seasonal average. (See Chart IV—Departure of the Mean Temperatures from the Normal, in January–June, 1917, issues of this REVIEW.)

The bureau issued special bulletins to approximately 400 persons or firms showing the stages of the river at the most important stations and containing warnings one, two, and three days in advance. The warnings were of very great practical value.

So far as can be ascertained, losses due to this year's high water were as follows:

Loss due to annual rise in Columbia River.

Tangible property, bridges, highways, etc.	Crops.		Suspension of business.	Removing and protecting goods.
	Matured.	Prospective.		
$15,000	$20,000	$100,000	$25,000	$6,000

SECTION V.—SEISMOLOGY.

SEISMOLOGICAL REPORTS FOR OCTOBER, 1917.

W. J. HUMPHREYS, Professor in Charge.

[Dated: Weather Bureau, Washington, D. C., Dec. 1, 1917.]

TABLE 1.—*Noninstrumental earthquake reports, October, 1917.*

Day.	Approximate time, Greenwich Civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
		CALIFORNIA.								
1917.	H. m.		° ′	° ′			M. s.			
Sept. 3	7 40	San Francisco	37 48	122 26	4	3		None		George Miller.
11	21 26	Salinas	36 36	121 40	4	1	2	None		Dr. E. D. Eddy.
		Spreckels	36 35	121 38	3	1	1	Rumbling		Dr. M. A. Klein.
14	0 50	San Francisco	37 48	122 26	2	1		None		O. E. Faubion.
16	23 50	Calexico	32 41	115 30	3	2	6	None		I. R. Ralston.
		Calexico	32 41	115 30	3	1	5	None		C. N. Perry.
26	9 18	Berkeley	37 52	122 16	3	2		None	Good record on instrument	E. F. Davis.
		Los Gatos	37 12	121 58	4	1	8	None		I. H. Snyder.
		San Francisco	37 48	122 26	3	1	2	None		G. H. Willson.
		San Jose	37 20	121 54	5	2	9	None		Maurice Connell.
		San Jose	37 20	121 54	3			None	Slight instrumental record	L. H. Kroeck.
		Stanford University	37 27	122 09	3	1	5			S. D. Townley.
27	3 49	Eureka	40 48	124 11	2	1	1	None	House creaked	James Jones.
		NEW JERSEY.*								
19	17 00	Northfield	39 22	74 32	3-4	1	Few	None	Doors and windows rattled. Other shocks at intervals.	Edna Ryan.
		Ocean City	39 18	74 34	3-4	1		None		B. F. Smith.
		Pleasantville	39 23	74 32	3	1		None		Eugene Swilkey.
		Somers Point	39 18	74 35	4		Few	None		Lucelda Looy.
		Ventnor	39 21	74 26	4	1	Few	None		Wm. A. Dunn.
		NEW YORK.								
2	2 14	Glens Falls	43 21	73 36	2-3	1	3	Rattling		C. L. Williams.

* Possibly due to gun firing.

TABLE 2.—*Instrumental reports, October, 1917.*

[Time used: Mean Greenwich, midnight to midnight. Nomenclature: International.]

[For significance of symbols see REVIEW for July, 1917, p. 373.]

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.

Alaska. *Sitka. Magnetic Observatory.* U. S. Coast and Geodetic Survey. J. W. Green.

Lat., 57° 03′ 00″ N.; long., 135° 30′ 06″ W. Elevation, 15.2 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants... $\begin{cases} & V & T_0 \\ E & 10 & 16.7 \\ N & 10 & 15.4 \end{cases}$

No earthquake recorded during October, 1917.

Arizona. *Tucson. Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. P. Ulrich.

Lat. 32° 14′ 48″ N.; long., 110° 50′ 06″ W. Elevation, 769.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants... $\begin{cases} & V & T_0 \\ E & 10 & 13.9 \\ N & 10 & 19.1 \end{cases}$

Date.	Character.	Phase.	Time.	Period T.	A_E	A_N	Distance.	Remarks.
1917.			H. m. s.	Sec.	μ	μ	km.	
Oct. 13		eP	4 24 40	4				
		eL	4 29 20	7				
		M_E	4 29 57	8	20			
		M_N	4 30 23	4		10		
		F	4 42 ..					
19		e_E	16 46 34	4				
		e_N	16 37 36	15				
		M_E	16 52 42	4	10			
		M_N	16 54 37	20		20		
		F_E	17 10 ..					

California. *Berkeley. University of California.*

Lat., 37° 52′ 16″ N.; long., 122° 15′ 37″ W. Elevation, 85.4 meters.

(See Bulletin of the Seismographic Stations, University of California.)

California. *Mount Hamilton. Lick Observatory.*

Lat., 37° 20′ 24″ N.; long., 121° 38′ 34″ W. Elevation, 1,281.7 meters.

(See Bulletin of the Seismographic Stations, University of California.)

California. *Point Loma. Raja Yoga Academy.* F. J. Dick.

Lat., 32° 43′ 03″ N.; long., 117° 15′ 10″ W. Elevation, 91.4 meters.

Instrument: Two-component, C. D. West seismoscope.

(Report for October, 1917, not received.)

California. *Santa Clara. University of Santa Clara.* J. S. Ricard, S. J.

Lat., 37° 26′ 36″ N.; long., 121° 57′ 03″ W. Elevation, 27.43 meters.

(See record of the Seismographic Station, University of Santa Clara.)

TABLE 2.—*Instrumental reports, October, 1917*—Continued.

Colorado. *Denver. Sacred Heart College.* Earthquake Station. A. W. Forstall, S. J.

Lat., 39° 40′ 36″ N.; long., 104° 56′ 54″ W. Elevation, 1,655 meters.

Instrument: Wiechert 80 kg.; astatic, horizontal pendulum.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Oct. 7	....	L_N....	21 31 ..					Time rather doubtful.
		M_N....	21 35 ..					Very irregular waves.
		C_N....	21 36 ..					
		F_N....	21 37 ..					
13	....	L_N....	21 49 ..					Sinusoidal waves constantly occurring on N-S.
		F_N....	21 55 ..					
13	....	L_N....	22 20 ..					
		F_N....	24 00 ..					
14	....	L_N....	1 30 ..					Visible activity at intervals from 1h 30m on.
15	....	L_N....	2 30 ..					Activity.
		F_N....	4 15 ..					
16-17	....							Strong activity on N-S all day.
17-18	....							Small but very distinct sinusoidal waves all day on N-S.
30	....	L_N....	2 20 ..					Sinusoidals at frequent intervals on N-S all day.
		F_N....	15 00 ..					

District of Columbia. *Washington. U. S. Weather Bureau.*

Lat., 38° 54′ 12″ N.; long., 77° 03′ 03″ W. Elevation, 21 meters.

Instrument: Marvin vertical pendulum, undamped. Mechanical registration.

Instrumental constants.. V 110, T_0 6.4

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Oct. 7	....	P	15 00 58				3,100?	
		S_N?	15 05 48					
		eL_E	15 10 10					
		F	15 20 00					
19	....	P.....	16 43 04				2,240	
		S.....	16 47 48					
		L.....	16 52 00					
		L.....	16 53 24	20				
		F.....	17 30 ..					
22	....	P.....	7 26 30				3,925	
		S.....	7 32 13					
		L.....	7 37 00					
		L.....	7 41 00	20				
		F.....	8 20 00					
23	....	eL....	8 03 30					
		F.....	8 10 00					

District of Columbia. *Washington. Georgetown University.* F. A. Tondorf, S. J.

Lat., 38° 54′ 25″ N.; long., 77° 04′ 24″ W. Elevation, 42.4 meters. Subsoil: decayed diorite.

Instruments: Wiechert 200 kg. astatic horizontal pendulums, 80 kg. vertical.

Instrumental constants...	V	T_0	ϵ
E	165	5.4	0
N	143	5 2	0
Z	*80*	*3.0*	*0*

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Oct. 19	....	e_E.....	16 42 07					Heavy microseisms. Heavy traffic markings because of heavy drayage near observatory.
		e_N.....	16 42 12					
		S_N?...	16 47 49					
		S_E?....	16 48 07					
		eL....	16 52 18					
		L_E....	16 54 47	24				
		L_N....	16 54 48	24				
		F.....	17 58 ..					
22	....	e_E?....	7 25 47					Heavy microseisms. No distinct maximum; interpretation difficult.
		e_N?....	7 26 21					
		eL_E...	7 36 24					
		eL_N...	7 37 00					
		L_E....	7 38 15					
		L_N....	7 42 33					
		F.....	8 37 00					

Hawaii. *Honolulu. Magnetic Observatory.* U. S. Coast and Geodetic Survey. Frank Neumann.

Lat., 21° 19′ 12″ N.; long., 158° 03′ 48″ W. Elevation, 15.2 meters.

Instrument: Milne seismograph of the Seismological Committee of the British Association.

Instrumental constant... T_0 18.6

(Report for October, 1917, not received.)

Kansas. *Lawrence. University of Kansas.* Department of Physics and Astronomy. F. E. Kester.

Lat., 38° 57′ 30″ N.; long., 95° 14′ 58″ W. Elevation, 301.1 meters.

Instrument: Wiechert.

Instrumental constants...	V	T_0	ϵ
E	177	3.4	4:1
N	205	3.4	4:1

(Report for October, 1917, received too late.)

Maryland. *Cheltenham. Magnetic Observatory.* U. S. Coast and Geodetic Survey. George Hartnell.

Lat., 38° 44′ 00″ N.; long., 76° 50′ 30″ W. Elevation, 71.6 meters.

Instruments: Two Bosch-Omori, 10 and 12 kg.

Instrumental constants...	V	T_0
E	10	15
N	10	15

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Oct. 19	....	eP_N...	16 43 03					Phases not well defined.
		eP_E...	16 44 00	4				
		eL_E...	16 52 54	16				
		M_N....	16 53 13	4		10		
		M_E....	16 56 30	13	70			
		C_E....	16 58 ..	12				
		F_E....	17 07 ..					

Massachusetts. *Cambridge. Harvard University Seismographic Station,* J. B. Woodworth.

Lat., 42° 22′ 36″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

Instruments: Two Bosch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants..	V	T_0	ϵ
E	80	23	0
N	50	25	4:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Oct. 7	....	*O*.....	*14 50 00*				5,015	Distance from L-S.
		S_E....	15 00 11	6				
		eL_E...	15 06 55	20				
		F.....	15 44 17					
13	....	L_E....	4 40 47	8				Compare with Ottawa record.
19	....	*O*.....	*16 37 33*				3,330	
		P_E....	16 44 47					
		S_E.....	16 49 11	6				
		eL_E?..	16 53 48	30				
		M_N....	16 58 —					
		F?....	17 25 —					F in microseisms.
22	....	*O*?....	*7 21 23*				3,375?	Distance from L-S.
		e_E.....	7 33 00	6?				e may be S?
		eL_E...	7 36 08	20				
		i_E.....	7 37 04	4				i intrusive?
		L.....	7 37 12	16				
		L.....	7 40 20	16				
		L.....	7 44 07	20				
		L.....	7 50 36	15				
		L.....	7 54 30	15				
		F?....	8					
30	....							Doubtful long waves from 10h, 18m to 10h 24m.

Missouri. *Saint Louis. St. Louis University.* Geophysical Observatory. J. B. Goesse, S. J.

Lat., 38° 38′ 15″ N.: long., 90° 13′ 58″ W. Elevation, 160.4 meters. Foundation: 12 feet of tough clay over limestone of Mississippi system, about 300 feet thick.

Instrument: Wiechert 80 kg. astatic, horizontal pendulum.

Instrumental constants.. V 80, T_0 7, ϵ 5:1

(Report for October, 1917, not received.)

TABLE 2.—*Instrumental reports, October, 1917*—Continued.

New York. *Buffalo.* *Canisius College.* John A. Curtin, S. J.

Lat., 42° 53′ 02″ N.; long., 78° 52′ 40″ W. Elevation, 190.5 meters.

Instrument: Wiechert, 80 kg., horizontal.

Instrumental constants.. V 80, T_0 7, ϵ 5:1

(Report for October, 1917, not received.)

New York. *Fordham.* *Fordham University.* W. C. Repetti. S. J.

Lat., 40° 51′ 47″ N.; long., 73° 53′ 08″ W. Elevation, 23.9 meters.

Instrument: Wiechert, 80 kg.

Instrumental constants..	V	T_0	ϵ
E	72	5	1.5:1
N	72	5	3.8:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Oct. 19		L	17 11 00					Possible error of a few seconds in the time.

New York. *Ithaca.* *Cornell University.* Heinrich Ries.

Lat., 42° 26′ 58″ N.; long., 76° 29′ 09″ W. Elevation, 242.6 meters.

Instruments: Two Bosch-Omori, 25 kg., horizontal pendulums (mechanical registration).

Instrumental constants..	V	T_0	ϵ
E	13	22	4:1
N	14	25	4:1

(Report for October, 1917, not received.)

Panama Canal Zone. *Balboa Heights.* Isthmian Canal Commission.

Lat., 8° 57′ 39″ N.; long., 79° 33′ 29″ W. Elevation, 27.6 meters.

Instruments: Two Bosch-Omori, 100 kg.

Instrumental constants.. V 35, T_0 20

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Oct. 22		P_E	7 20 44				740	Direction?
		P_N	7 21 10					
		L_E	7 22 20					
		L_N	7 22 46					
		M_N	7 23 06			*57		
		M_E	7 23 10		*86			
		F_E	7 45 00					
		F_N	7 48 00					
28		P	13 24 48				630	
		L_N	13 26 10					
		M_N	13 26 14			*200		
		L_E	13 26 18					
		M_E	13 26 34		*200			
		F_E	13 53 12					
		F_N	13 55 08					

* Trace amplitude.

Porto Rico. *Vieques.* *Magnetic Observatory.* U. S. Coast and Geodetic Survey. F. L. Adams.

Lat., 18° 09′ N.; long., 65° 27′ W. Elevation, 19.8 meters.

Instruments: Two Bosch-Omori.

Instrumental constants..	V	T_0
E	10	17.5
N	10	18.2

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Oct. 19		eP_E	16 47 50					
		eP_N	16 48 36	4				
		eL_E	16 52 43	16				
		eL_N	16 53 00	16				
		M_E	16 55 32	14	20			
		M_N	16 56 32	12		10		
		F	17 12 ..					
22		eP_N	7 24 12	4				
		eP_E	7 24 20					
		eL_E	7 27 52	14				
		eL_N	7 27 56	10				
		M_E	7 28 16	10	30			
		M_N	7 28 30	10		10		
		F_E	7 50 ..					

Vermont. *Northfield.* *U. S. Weather Bureau.* Wm. A. Shaw.

Lat., 44° 10′ N.; long., 72° 41′ W. Elevation, 256 meters.

Instruments: Two Bosch-Omori, mechanical registration.

Instrumental constants..	V	T_0
E	10	15
N	10	16

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Oct. 19		eL_E	16 52 00					
		F	17 15 00					

Canada. *Ottawa.* *Dominion Astronomical Observatory.* Earthquake Station. Otto Klotz.

Lat., 45° 23′ 38″ N.; long., 75° 42′ 57″ W. Elevation, 83 meters.

Instruments: Two Bosch photographic horizontal pendulums, one Spindler & Hoyer 80 kg. vertical seismograph.

Instrumental constants.. V 120, T_0 26

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Oct. 7		*O*	*14 55 49*				2,750	Readings from deformation instrument.
		P	15 01 21					
		S_E	15 05 45					
		L	15 08 24					
13		eL	4 40 ..	20				
19		*O*	*16 37 11*				3,600	A further outcrop of short-period waves resembling P on both instruments at 16h 54m.
		P_N	16 43 59					
		S_N	16 49 23					
		eL?	16 53 30					
		L	16 56 ..	30				
		L	17 00 ..	14				
		F	17 20 ..					
22		e	7 53 50	2				
		L	{ 7 40 .. / 7 50 .. }	17				

Canada. *Toronto.* *Dominion Meteorological Service.*

Lat. 43° 40′ 01″ N.; long., 79° 23′ 54″ W. Elevation, 113.7 meters. Subsoil: Sand and clay.

Instrument: Milne horizontal pendulum, North. In the meridian.

Instrumental constant.. T_0 18. Pillar deviation: 1 mm. swing of boom = 0.50″.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	μ	μ	*km.*	
Oct. 7		L?	15 26 42					
		L	15 45 12					
		M			*300			M and F in air currents.
13		L	5 00 18		*50			
		F	5 06 36					
19		P	16 39 48					Air currents going on. P and S very doubtful.
		P	16 42 47					
		S	16 46 42					
		S	16 49 18					
		L	16 51 36					
		iL	16 55 48					
		M	16 57 00		*1,300			F in air currents.
20		L?	18 35 36					
		L?	18 44 18		*200			
22		S_E?	7 33 12					
		iL	7 36 24					
		M	7 37 36		*800			
		L	7 46 18					
		L	8 06 24					
		F	8 24 24					
23		L?	8 04 18		*50			Air currents going on.
28		L_E	13 40 36					
		L	13 43 42					
		M	13 46 36		*800			
		F	14 10 30					
28		L	17 52 12					Other phases lost, attending instruments.
29		L?	21 41 30					
		L	21 47 18					
		M	21 51 42		*300			
		F	22 58 18					

*Trace amplitude.

TABLE 2.—*Instrumental reports, October, 1917*—Continued.

Canada. *Victoria, B. C. Dominion Meteorological Service.*

Lat., 48° 24′ N.; long., 123° 19′ W. Elevation, 67.7 meters. Subsoil: Rock.

Instrument: Weichert, vertical; Milne horizontal pendulum, North. In the meridian

Instrumental constant.. T_0 18. Pillar deviation, 1 mm., swing of boom = 0.54″.

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Oct. 7		P	15 21 34				2,490?	
		S?	15 25 38					
		L	15 30 35					
		M	15 35 33		*500			
		F?	15 49 55					
13		L	4 40 00					Minute and sharp vibrations.
		L	4 43 24		*100			
		F	4 50 06					
19		P	16 44 24				5,250	
		S	16 51 20					
		L	17 00 46					
		M	17 07 42		*500			
		F	17 36 28					
			VERTICAL.		A_z			
		M	*17 07 00*	*14–16*	*1*			
20		L	18 15 09					
		M	18 21 42		*200			
		F	18 29 39					
22		P or S?	7 42 06					
		L	7 51 01					
		M	7 56 28		*400			
		F	8 21 46					
23		P	8 05 58					
		L	8 11 25					
		M	8 14 53		*200			
		F	8 19 51					
28		L	13 57 20		*50			
		F	14 09 20					
28		L	17 50 44		*100			
		F	18 14 14					
29		P	20 59 20					S?
		L	21 17 42					
		M	21 30 35		*300			
		F	21 46 57					

* Trace amplitude.

SEISMOLOGICAL DISPATCHES.[1]

There were no press reports of seismological or vulcanological disturbances during October, 1917.

[1] Reported by the organizations indicated and collected by the seismological station at Georgetown University, Washington, D. C.

TABLE 3.—*Late seismological reports.* (*Instrumental.*)

Massachusetts. *Cambridge. Harvard University Seismographic Station,* J. B. Woodworth.

Lat., 42° 22′ 36″ N.; long., 71° 06′ 59″ W. Elevation, 5.4 meters. Foundation: Glacial sand over clay.

Instruments: Two Bosch-Omori 100 kg. horizontal pendulums (mechanical registration).

Instrumental constants..		V	T_0	ε
	E	80	23	0
	N	50	25	4:1

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1917.			*H. m. s.*	*Sec.*	*μ*	*μ*	*km.*	
Sep. 18		e?	18 53 49					e in microseisms.
		L	18 54 42	24				F?, after 19h 05m.
18		*O?*	*22 04 07*				5,280?	P in microseisms; *O* from eL–S.
		eP?	22 13 20					
		S_E	22 19 50	6				
		eL_E	22 25 53	24				
		L	22 38 54	16				
		F	22 51 ..					
20		L_E	3 41 16					L possibly earlier.
		L	4 03 20	15				
		L	4 16 14	14				L from southward.
		F	4 30 25					
21		*O?*	*8 45 04*				3,425?	*O* and distance from L–S.
		eP?	8 54 11					
		i	8 54 46					
		S_E	8 56 50	6				
		S_N?	8 57 56	6				
		eL_E	9 00 16	12				
		eL_N	9 00 54	9				
		L_E	9 02 43	6				
		F_E	9 04 54					
24		e_E	21 02 24	20				Forepart irregular.
		L_E	21 14 36	24				
		L	{21 17 16 / 21 25 24}	20–18				
31		*O?*	*21 36 05*				920?	Doubtful record, subject to confirmation.
		P?	21 38 07					
		S?	21 39 47	6				
		eL_N	21 40 07					
		eL_E	21 40 11	12				
		L_N	21 40 38	13				F in microseisms.

EARTH TREMOR DUE TO THUNDER NOTES.[2]

Mr. Douglas F. Manning, Alexandria Bay, N. Y., sends the following report under date of October 28, 1917:

A peculiar effect of thunder was felt here last night (Oct. 27, 1917), between the hours of 10 and 11 p. m. The day had been ideal with a light south wind, mild temperature, and a few alto-cumuli moving lazily from the west; in fact, it was an "Indian Summer" type of day. Toward evening my aneroid began to fall rapidly and the clouds increased, and by 8 o'clock a rain was falling. At about 10 [p. m.] I noticed a flash of lightning, and this was followed in a short interval by a deep, prolonged rumble, causing windows and doors to rattle, chinaware to jar, and a distinct earth tremor was felt; in fact, many thought it was one. The lightning increased in intensity and frequency and the same marked earth tremors followed each flash at short intervals, and it seemed as if a series of earthquakes were taking place, so strong was the concussion produced. The storm gradually passed over accompanied by a tremendous but brief downpour of rain mixed with small hail, and by 11 o'clock all was still again.

To-day one hears many stories of the storm and its peculiar behavior, all making note of the trembling effect produced.

This instructive letter is published for the benefit of others interested in these problems.

Since "musical" notes of very low pitch and great volume are occasionally produced by a series of sequent or pulsating lightning discharges, it seems probable that the shaking described by Mr. Manning was owing in great measure to the resonance response of rooms to thunder notes of this character.—*W. J. Humphreys.*

[2] In this connection compare *W. Schmidt* "On Thunder," MONTHLY WEATHER REVIEW, December, 1914, 42 : 665 ffg.

SECTION IV.—BIBLIOGRAPHY.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

American climatological and clinical association.
Transactions for the year 1916. volume 32. Philadelphia. 1916. xlvii, 353 p. plates. illus. tables. diagr. 24½ cm.

Arkansas. Agricultural experiment station.
Blooming period of the apple in northwest Arkansas. Fayetteville, Ark. 1917. 12 p. illus. tables. 23cm. Bulletin no. 134.

Bertolini, G. L.
L'orologio solare di Aquileia e la sistemazione della rosa dei venti nel medio evo. illus. diagrams, 24 cm. (Excerpted from Bollettino della Reale società geografica italiana, serie 5, vol. 5. no. 12. 1° dicembre, 1916. p. [969]-985.)

Chile. Instituto meteorológico y geofísico.
... Observaciones meteorológicas en Santiago (Resúmenes) 1911-1915. Santiago. 1917. 49 p., 1. tables (part. fold.) charts (part. fold.) 26 cm. Sección meteorológica no. 21.

... Recopilacion de sumas de agua caida en Chile, 1849-1915. Santiago. 1917. 99 p., 2 l. tables. 2 fold. charts. 27 cm. Seccion lluvias. Publication no. 20.

Fowle, F[rederick] E[ugene].
Water-vapor transparency to low temperature radiation. Washington. 1917. 1 p. l., 68 p. incl. tables. charts. 24½ cm. At head of title: Smithsonian miscellaneous collections, volume 68, number 8. (Publication 2484).

Great Britain, Meteorological office.
The computer's handbook. Section II. Sub-section II—Computation of height and temperature by means of registering balloons. Sub-section III—The dynamics of the upper air. Subsection IV—Tables for the estimation of geostrophic winds. London. 1917. 74 p. illus. tables. 24½ cm. At head of title: For official use. M. O. 223.

Monthly meteorological charts of Baffin Bay and Davis Strait [May-October, 1916]. London. 1916. charts. 67½ x 79 cm. M. O. no. 221.

Guiche, Armand de Gramont, duc de.
... Essai d'aérodynamique du plan. Paris. 1911-1914. 4 v. plates. tables. diagrams. charts. 28½ cm. Publications du Laboratoire de Guiche, v. 1-4.

Hall, Charlotte Maxwell.
Report on the hurricane in Jamaica. September 23, 1917. Kingston. [1917.] cover-title. 8 p. incl. tables. charts. 34½ cm. No. 474.

Hands, Alfred.
Lightning conductors. London. n. d. 16 p. 21½ cm. At head of title: "The electrical engineer" reprints. New series—no. 1.

Necessary practical safeguards against lightning. A paper read before the International fire prevention congress, 1903. London. [1903.] 28 p. illus. 18½ cm.

Protection against lightning. What is a lightning conductor? How does it protect against lightning? And how should it be applied to be effective? [London.] 1914. 11 p. illus. 22 cm.

Protection of buildings from lightning. A lecture delivered at the school of military engineering, Chatham, on December 6, 1906. London. [1907] 2 p. l., 17 p. fold. plate. 24 cm. (Reprinted from "The royal engineers' journal."—March, 1907.)

Scientific protection: A guide to the proper application of lightning conductors. London. [1902.] 32 [2] p. 25 cm.

Hill, M[ontague].
Note on an inquiry by the Government of India into the relation between forests and atmospheric and soil moisture, in India. Calcutta. 1916. p. l., 41 p. incl. tables. fold. chart. fold. map. 25 cm. At head of title: Forest bulletin no. 33. [Compare this REVIEW, September, 1917, p. 453, col. 2.]

Indo-China. Service météorologique.
Bulletin pluviométrique. Année 1916. Phu-Lien. 1917. unp. tables. charts (part. fold.). 40 cm.

Italy. R. Esercito italiano. Sezione meteorologica.
Bacino del Timavo; cenni e dati climatici e geografici. Roma. 1917. [4] p. 14 cm. Pubbl. N. 19.

Bacino dell 'Isonzo; cenni e dati climatici e geografici. Roma 1917. [4] p. 14 cm. Pubbl. N. 17.

Joly, John.
On the amount of radium emanation in the soil and its escape into the atmosphere, by John Joly and L. B. Smyth. London. 1911. cover-title. 6 tables. diagr. fold. chart. 27½ cm. (Scientific proceedings of the Royal Dublin Society, vol. 13, N. S., no. 11. August, 1911. p. 148-161.)

Mohn, H[enrik].
Der Luftdruck zu Framheim und seine tägliche Periode. Kristiania. 1916. 30 p. incl. tables. 27½ cm. At head of title: Roald Amundsen's Antarktische Expedition. Wissenschaftliche Ergebnisse. Videnskapsselskapets Skrifter. 1. Mat.-naturv. Klasse 1916. no. 3.)

New York central lines. Office of consulting engineer, rails, tires, and structural steel.
Chart of mild and cold winters. New York. 1917. fold. sheet. incl. 2 tables. chart. 26½ x 61 cm.

Norway. Meteorologiske institut.
Aarsberetning for budgetaaret 1. Juli 1916 til 30. Juni 1917. Kristiania . . . 1917. 12 p. 23 cm.

Meteorologien i Norge i 50 aar: festskrift utgit av det Norske meteorologiske institut i anledning av dets 50-aarsjubilaeum, 1 December, 1916. Kristiania. 1917. 3 p. l., 138 p. illus. tables. charts. 28 cm.

Panama (Republic). Direccion general de estadistica.
Compendio estadistico descriptivo de la Republica de Panama con los datos sinopticos del comercio internacional de 1909 a 1916. [Panama.] 1917. cover-title, vi, [3]-220, iii p. tables. 21 cm. [Gives mean annual temperature for numerous towns.]

Patterson, J[ohn].
Long-range forecasting and other weather illusions. charts. tables. 23½ cm. (Reprinted from the Journal of the Royal astronomical society of Canada, September, 1917.)

Pennsylvania. State college. Agricultural experiment station.
Meteorological observations for 1914, by H. D. Edmiston. Harrisburg, Pa. 1917. tables. 23 cm. (Reprint from the annual report for 1914-15. Separate no. 12 (p. 425-433, 497-522.)

Pinauda, F.
Nozioni di meteorologia ossolana ossia il clima dell 'Ossola Superiore desunto dalle osservazioni del quarantennio 1872-1911... Domodossola. 1914. [7]-117 p. illus. tables. charts. map. 32 cm.

Piquet, Victor.
Le Maroc; géographie—histoire—mise en valeur. Paris. 1917. xii, 464 p. 4 fold. maps. 20 cm. [Climate, p. [19]-28.]

Radcliffe observatory, Oxford.
Results of meteorological observations in the year 1916. v. 52. pt. 1. Oxford. 1917. cover-title. 20 p. incl. tables. 26 cm.

Wallén, Axel.
1914 års torka och dess inverkan på sjöarnas avlopp, av Axel Wallén och Richard Smedberg. Stockholm. 1917. tables. charts (part. fold.). 31 cm. (Särtryck ut Hydrografiska byråns årsbok för 1914, p. 25-72.)

Om temperaturens och nederbördens inverkan på granens och tallens höjd-och radietillväxt å stanmäs kronopark, 1890-1914. Stockholm. 1917. cover-title. 5 tables. 2 charts. 26 cm. (Särtryck ut Skogshögskolans festskrift, 1917, p. [413]-427.)

Walz, F[erdinand] J.
Killing frost and length of the growing season in various sections of Kentucky. Lexington, Ky. 1917. 5 tables. 4 charts. 22½ cm. (Kentucky Agricultural experiment station. Circular no. 19, p. 121-132.) [Compare this REVIEW, July, 1917, p. 348-353.]

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers and other communications bearing on meteorology and cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled. It shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau.

Aeronautical journal. London. v. 21. July–September, 1917.
Cave, C. J. P. Some meteorological conditions which increase the danger of flying. p. 301–312.

American academy of arts and science. Proceedings. Boston. v. 52. October, 1917.
Ward, Robert DeC[ourcy]. Cleveland Abbe (1838–1916.) p. 827–829.

American climatological and clinical association. Transactions. Philadelphia. v. 32. 1916.
Miller, James Alexander. Some physiological effects of various atmospheric conditions. p. 1–14. [Bibliography, p. 14.]

British association for the advancement of science. Report. London. 86th meeting Newcastle-on-Tyne. 1916.
Anderson, V. G., Avery, D., & Hunt, H. A. The influence of weather conditions upon the amounts of nitrogen acids in the rainfall and atmosphere in Australia. p. 128–129. [See this issue of the REVIEW, p. 501.]

Franklin institute. Journal. Philadelphia. v. 184. November, 1917.
Humphreys, W[illiam] J[ackson]. Physics of the air. Chap. —, p. 651–674.

Geographical review. New York. v. 4. November, 1917.
McAdie, Alexander. Saving the crops from injury by frost. p. 351–358.

Literary digest. New York. v. 55. October 17, 1917.
Denatured hailstorms in France. p. 23. [Abstract from Revue générale de l'électricité. Describes the "electrical sweep-net" devised by P. Marcillac.]

London, Edinburgh and Dublin philosophical magazine. London. ser. 6. v. 34. 1917.
Nesta, Thomas, & Ferguson, Allan. On evaporation from a circular water surface. p. 308–321. (October.)
Jeffreys, Harold. On periodic convection currents in the atmosphere. Second paper. p. 449–458. (November.)

Meteorological society of Japan. Journal. Tokyo. 36th year. October, 1917.
Fujiwhara, Sakuhei. Rimarko pri forma de ciruso. p. 87–89.

Nature. London. v. 100. October 25, 1917.
Strutt, R. J. Transparency of the atmosphere for ultra-violet radiation. p. 144. [This REVIEW, p. 485.]

Royal society of London. Proceedings. London. ser. A. v. 93. No. A655. October 9, 1917.
Fowler, A., & Strutt, R. J. Absorption bands of atmospheric ozone in the spectra of the sun and stars. p. 577–586.

Scientific American. New York. v. 117. November 3, 1917.
Measuring daylight. p. 338. [Tungsten used as a substitute for selenium.]

Scientific monthly. New York. v. 5. 1917.
Burgess, George K. Applications of science to warfare in France. p. 289–297. (October.) [Describes among other things the work of the meteorologists attached to the Allied armies.]
Abbot, C[harles] G[reeley]. The sun and the weather. p. 400–410. (November.)

Seismological society of America. Bulletin. Palo Alto. v. 7. September, 1917.
Finch, Ruy H. The Missouri earthquake of April 9, 1917. p. 91–96.
Wood, Harry O. A further note on seismometric bookkeeping. p. 106–112.
Hamlin, Homer. Earthquakes in southern and eastern California. p. 113–118.
Saderra Masò, Miguel. Notes concerning the Ragang volcano and a great earthquake in South Mindanao. p. 119–121.

Scottish geographical magazine. Edinburgh. v. 33. November, 1917.
Mackie, G. B. Geography in relation to war. p. 498–507.

Tennessee academy of science. Nashville. v. 2. January 1, 1914–May 5, 1917.
Nunn, Roscoe. West Indian hurricanes; their origin, movement, and extent. p. 92–93. [Brief abstract.]
Nunn, Roscoe. The climate of Sewanee, Tennessee. p. 94. [Brief abstract.]

Tycos-Rochester, Rochester. v. 7. October, 1917.
Lawrence, John. The devitalized air of winter living rooms. p. 18.
Hoffman, Frederick L. Maximum temperature in which a workman can work. p. 20; 21.

Académie des sciences. Comptes rendus. Paris. Tome 165. 29 octobre, 1917.
Chauveau, A. B. Sur la variation diurne du potentiel en un point de l'atmosphère par ciel serein. p. 594–597.

Astronomie. Paris. 31 année. Octobre, 1917.
Guillaume, Ch[arles] Éd[ouard]. La visibilité des ondes sonores. p. 360–363.
Maurer, Jules. L'hélio-chronographe de précision. p. 363–365.
Renaudot, G. Le soleil et l'atmosphère terrestre. p. 365–368. [Abstract of memoir by Clayton.]
Le canon et la pluie. p. 371–374. [Summary of recent literature on the subject.]

Sociedad científica "Antonio Alzate." Memorias y revista. Mexico. Tome 36. 1a partie. Junio, 1917.
Palacios, Enrique Juan. Puebla, su territorio y sus habitantes. p. 9–328. [Climate, p. 140–173.]

Pontificia accademia romana dei Nuovi Lincei. Memorie. ser. 2. v. 2. 1916.
Giorgi, Cosimo De. Ricerche su i terremoti avvenuti in terra d'Otranto dal 1898 al 1915. p. 33–50.
Negro, Carlo. Sul clima della Libia attraverso i tempi storici. Memoria 3. p. 121–183.
Galli, Ignazio. Supplemento alla storia, ai caratteri, e agli effetti del fulmine globulare. Memoria sesta. p. 219–286.

Società geografica italiana. Bollettino. Roma. v. 5. Dicembre, 1916.
Eredia, Filippo. Sul clima di Salonicco. p. 986–1006.

Società geografica italiana. Bollettino. v. 6. 1917.
Bertolini, G. Lod. L'orologia solare di Aquileia e la sistemazione della rosa dei venti nel medio evo. p. 969–985. (Aprile-maggio.)
Fiore, O. De. I terremoti di Filicudi (Isole Eolie) nel 1916. p. 363–364. (Aprile-maggio.)
Eredia, Filippo. Sul clima di Bagdad. p. 436–444. (Giugno.)
Fiore, O. De. Terremoti dei Campi Flegrei avvenuti negli anni 1908, 1911, 1913. p. 445–448.

Società meteorologica italiana. Bollettino bimensuale. Torino. v. 35. Ottobre–noviembre, 1916.
Masini, Alberto. Sui fattori di condensazione del vapor acqueo nell'atmosfera. p. 49–56. [Repr. from Nuovo Cimento.]

SECTION VII.—WEATHER AND DATA FOR THE MONTH.

THE WEATHER OF OCTOBER, 1917.

P. C. DAY, Climatologist and Chief of Division.

[Dated: Climatological Division, Weather Bureau, Dec. 1, 1917.]

PRESSURE AND WINDS.

The distribution of the mean atmospheric pressure over the United States and Canada, and the prevailing direction of the winds for October, 1917, are graphically shown on Chart VII (XLV—101), while the means at the several stations, with the departures from the normal, are shown in Tables I and III.

October, 1917, opened with relatively high pressure in the Central Valleys, but it was below normal in the northeastern districts and in the northern portion of the Rocky Mountains and Plains States; elsewhere it was generally near the seasonal average.

During the first half of the month the pressure was, as a rule, below the normal in most of the northern sections, while in the central and southern districts it was relatively higher than the average during the greater part of this period. About the middle of the month lower pressure overspread most sections, but in a few days there was a return to higher readings, and while a number of rather extensive low and high pressure areas moved across the country at intervals during the remainder of the month, the pressure generally averaged above the normal throughout the southern districts, the Great Plains States, and to the westward. In the northern States from the Mississippi Valley eastward it was below the seasonal average. The month closed with pressure above normal in all districts except the Lakes Region and to the eastward where it was slightly below the average.

For October, as a whole, the barometric pressure averaged above the normal in all sections of the country, except the Lakes Region, the Ohio, and upper and middle Mississippi valleys, and portions of the Middle Atlantic States, where it was below the seasonal average. The departures were generally not large, although in the North Pacific States they ranged from +0.10 to +0.20 inch.

The distribution of the HIGHS and LOWS resulted in prevailing southerly winds in most of New England, the lower Lakes Region, in Texas and portions of adjacent States. Westerly and northwesterly winds were frequent in the upper Lakes Region, the upper Mississippi and the Missouri valleys, while in the South Atlantic and East Gulf States the prevailing direction was northerly. Elsewhere variable winds prevailed.

TEMPERATURE.

The first decade of October was cool in most eastern districts, with marked temperature departures from the normal in the Lakes Region and the upper Mississippi Valley. In the Western States hot weather prevailed, especially in the interior of California, in Oregon, and the Plateau Region. Killing frosts occurred during the latter part of this period over most of the Ohio Valley, Nebraska, Iowa, Illinois, Missouri, and Kansas, and parts of States farther south, being at a few points one of the earliest killing frosts on record. (See p. 504-506.)

During the second decade the temperature averaged above normal west of the Rocky Mountains and close to normal in the southern half of the Plains Region; but in the Missouri Valley and eastern half of the country the period was colder than usual, especially from the Dakotas to Michigan. The temperature during the last 11 days of October averaged above normal in the Pacific States and about normal in the Plateau and New England States. Elsewhere the period was considerably colder than usual, the deficiency in temperature averaging about 10 degrees in the Middle Plains, the Central Valleys and western Lakes Region. Killing frost during the latter part of the month reached almost all interior points of Texas, being the earliest on record at many points in that State. From Idaho and Wyoming to Texas and in the Ohio and Missississpi valleys many stations at this time recorded the coldest weather ever known in October, and at a few points in the Atlantic States from Georgia to New Jersey new low temperature records for the month were made.

In the Ohio, the middle and upper Mississippi valleys, and the Lakes Region the temperature for October, 1917, as a whole, averaged from 6 to 9 degrees below the normal, which classes this as the coldest October of record in those districts. Elsewhere from the Rocky Mountains eastward, the month was likewise colder than usual, but the deficiencies were smaller. West of the Rockies the month was warmer than the seasonal average, especially in portions of California, where the positive departures were 6 degrees or more. In portions of the Ohio Valley October was the seventh successive month that the average temperature had been below the normal. This condition thus covered practically the entire growing season of the present year. In the far southwestern districts some high temperatures occurred during the month, the highest of record for October at a regular reporting station being 112° at Needles, Cal., while half the reporting stations in that State had temperatures of 100° or higher. On the other hand, temperatures below 0°F. were experienced in portions of the northern Rocky Mountains district, the lowest reported being −12° at Sheridan, Wyo., on the 29th. Freezing temperature occurred throughout the entire country, except along the eastern, southern, and western borders.

PRECIPITATION.

The first decade of October, 1917, was generally dry over most of the country, except that some rain fell in the Middle and North Atlantic States, the Ohio and lower Mississippi valleys, and the Lakes Region. During the next few days there was some precipitation in the Ohio and upper Mississippi valleys, the Lakes Region, and the northeast, and during the latter half of the second decade light rains occurred in the Missouri Valley and Plains States with liberal amounts in the Mississippi Valley and eastward. Early in the third decade rain fell in the Lakes Region, the Ohio Valley, and the Atlantic States north of Virginia; during the remainder of the month stormy weather and widespread precipitation prevailed much of the time in the upper Mississippi and lower Missouri valleys and eastward. Amounts were large in portions of the Atlantic States from North Carolina to Maine.

During the last few days of the month snow occurred in portions of the Rocky Mountains States, the Lakes Region, and in the northern Appalachian Mountains; some localities in the last-named district received as much as 12 inches or more. The month closed with generally fair weather throughout the country, except in the Lakes Region and extreme northeastern districts, where occasional light rain or snow prevailed.

For the month as a whole the precipitation was ample to excessive in the northeastern quarter of the country, but was scanty in almost all parts of the Cotton States, and from the Great Plains westward. In practically all of the western Plateau districts and California the month was rainless, which was also the case in portions of the southern Plains and over much of Texas. Along the northern Pacific coast where 6 to 10 inches of rain normally occur in October, only limited areas received as much as 1 inch.

RELATIVE HUMIDITY.

The relative humidity for the month as a whole was above the normal in the northern part of the country, except at points in the Dakotas and generally in the northern Rocky Mountain and Plateau regions, where it was below the average. Elsewhere, the atmosphere was relatively drier than the October average, particularly in the central and southern Plains States, and the central Plateau region, and to the westward, where the averages ranged from 10 to 20 per cent below the normal.

GENERAL SUMMARY.

The weather for October as a whole was unfavorable from an agricultural point of view. The maturing of late crops was checked in central and northeastern districts by low temperature during the first part of the month, and before the close freezing weather occurred nearly to the Gulf and south Atlantic coasts, doing considerable damage to winter truck crops and other vegetation. Dry weather prevented preparations for the seeding of winter grains or delayed the germination of the seed in much of the southwestern and western parts of the country, and cloudy, rainy weather from the Ohio Valley northeastward, interfered with the proper drying of corn in the shock. Conditions were favorable for outdoor work in much of the South and Southwest, but unfavorable in the Northeast. Cotton in some localities was injured by the low temperature and frost; potatoes were damaged to some extent in the northern and central parts of the country and in the Rocky Mountains Region. Pastures and ranges had insufficient moisture in many sections, and feed and water were so scarce on the southwestern ranges that stock was shipped to more favorable localities. The weather was generally favorable for fruits, although some apples were damaged by freezing in the Rocky Mountains Region.

SEVERE LOCAL STORMS.

The following notes of severe local storms during October, 1917, have been extracted from reports by officials of the Weather Bureau:

Missouri.—About 7 p. m., October 28, a tornado occurred at the head of Clear Creek, about 10 miles west of Springfield. It moved northward along a path about one-half mile wide and 18 miles long, demolishing houses, barns, and outbuildings, killing stock and destroying trees. Estimated damage, $20,000.

Average accumulated departures for October, 1917.

Districts.	Temperature.			Precipitation.			Cloudiness.		Relative humidity.	
	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure for the current month.	Accumulated departure since Jan. 1.	General mean for the current month.	Departure from the normal.	General mean for the current month.	Departure from the normal.
	°F.	°F.	°F.	In.	In.	In.	0-10		P. ct.	
New England	48.5	−1.8	−13.6	4.83	+1.20	−0.30	5.7	+0.3	81	+3
Middle Atlantic	51.6	−4.1	−10.9	5.00	+1.80	−1.30	4.9	+0.2	75	−1
South Atlantic	60.5	−3.2	+0.1	1.43	−2.60	−8.90	3.2	−0.8	75	−2
Florida Peninsula	76.5	0.0	+2.8	3.28	−3.00	−8.10	5.8	+1.2	78	−1
East Gulf	60.7	−4.6	−1.4	0.99	−1.80	−4.00	2.4	−1.4	69	−4
West Gulf	63.5	−3.1	+0.5	0.88	−1.90	-11.80	2.4	−1.3	62	−10
Ohio Valley and Tennessee	50.4	−6.2	−18.8	3.12	+0.60	+2.50	5.5	+1.1	70	−2
Lower Lakes	45.4	−6.4	−26.8	5.54	+2.60	+2.30	7.6	+1.8	76	+2
Upper Lakes	40.3	−7.3	−32.5	3.60	+0.80	−2.30	7.9	+1.9	79	+1
North Dakota	35.3	−7.0	−20.9	0.82	−0.40	−8.60	6.4	+1.2	74	+2
Upper Mississippi Valley	44.4	−8.4	−28.1	1.95	−0.50	−1.90	6.6	+2.1	70	−3
Missouri Valley	46.0	−6.7	−14.9	0.54	−1.40	−4.60	4.8	+0.7	60	−6
Northern Slope	43.1	−1.3	−18.9	0.56	−0.40	−1.40	5.1	+0.8	64	0
Middle Slope	51.3	−4.3	−9.1	0.40	−1.10	−6.40	3.6	+0.1	53	−8
Southern Slope	61.3	−1.1	+3.9	0.12	−2.00	−7.20	1.9	−1.8	42	−22
Southern Plateau	62.8	+2.9	−5.0	0.05	−0.60	−2.10	1.0	−1.2	41	−3
Middle Plateau	53.2	+2.4	−24.6	T.	−0.80	−2.30	1.6	−1.7	35	−15
Northern Plateau	52.0	+2.6	−12.6	0.03	−1.20	−1.90	5.7	+1.1	60	−1
North Pacific	53.5	+1.8	−7.6	1.00	−2.90	−8.60	5.7	−0.7	60	−23
Middle Pacific	63.0	+4.3	−1.5	0.00	−1.60	−8.00	3.4	−0.4	54	−13
South Pacific	66.5	+4.2	+6.7	0.06	−0.80	−3.30	3.2	+0.1	64	−3

WEATHER CONDITIONS OVER THE NORTH ATLANTIC OCEAN DURING OCTOBER, 1916.

The data presented are for October, 1916, and comparison and study of the same should be in connection with those appearing in the REVIEW for the month.

Chart IX (XLV—102) shows for October, 1916, the averages of pressure, temperature, and prevailing direction of the wind at 7 a. m. 75th meridian time (Greenwich mean noon). Notes on the locations and courses of the more severe storms of the month are included in the following general summary.

PRESSURE.

The mean atmospheric pressure for the month was unusual in some respects. The Azores or North Atlantic HIGH, with a crest of 30.25 in., was practically normal in position, while the Icelandic LOW, with a minimum reading of 29.55 in. was considerably south of its usual location. The intensity of both these areas was greater than ordinary, and the steep gradient between them was responsible for the frequency of gales within the intermediate territory.

The most remarkable feature, was the unusually low pressure that prevailed in West Indies waters during the month, due to the comparatively large number of West Indies hurricanes that passed over that region. The point of average lowest pressure was located to the southward of Cuba, where the average pressure for the month was about 29.80 inches. The variations in pressure from day to day were not remarkably large, and the means for the three decades of the month differed somewhat less than usual, as shown by the following table that gives for a number of selected 5-degree squares the average pressure for each of the three decades, as well as the highest and lowest individual readings reported during the month within the respective squares:

Pressures over the North Atlantic during October, 1916, by 5-degree squares.

Position of 5-degree squares.		Decade means.			Extremes.			
					Highest.		Lowest.	
Latitude.	Longitude.	I	II	III*	Pressure.	Date.	Pressure.	Date.
°	°	Inches.	Inches.	Inches.	Inches.	Oct.	Inches.	Oct.
60-65 N	20-25 W	29.57	29.61	29.38	30.08	1	29.00	24
60-65 N	0- 5 W	29.57	29.60	29.54	30.11	1	28.89	31
60-65 N	5-10 E	29.62	29.62	29.79	30.02	1	28.90	15
55-60 N	35-40 W	29.59	29.71	29.56	30.00	1	29.32	30
55-60 N	15-20 W	29.56	29.73	29.28	30.10	1	28.70	24
55-60 N	0- 5 E	29.68	29.81	29.61	30.20	1	29.10	31
50-55 N	55-60 W	29.85	29.88	30.02	30.41	19	29.42	6
50-55 N	45-50 W	29.69	29.83	29.90	30.32	20	29.38	10
50-55 N	20-25 W	29.60	29.96	29.52	30.45	15	29.21	30
50-55 N	10-15 W	29.70	29.99	29.36	30.22	15	29.00	30
45-50 N	65-70 W	30.11	29.93	30.13	30.52	23	29.40	17
45-50 N	40-45 W	29.75	30.01	30.04	30.56	20	29.48	2
45-50 N	15-20 W	29.87	30.24	29.70	30.48	15	29.38	24
40-45 N	70-75 W	30.22	30.06	30.18	30.50	19,23,29	29.54	17
40-45 N	55-60 W	30.04	30.14	30.23	30.63	19	29.65	10
40-45 N	20-25 W	30.04	30.41	30.03	30.62	15	29.62	1
40-45 N	0- 5 W	30.20	30.25	29.94	30.41	11	29.80	24
35-40 N	65-70 W	30.13	30.14	30.10	30.40	5,19	29.78	10,31
35-40 N	30-35 W	30.07	30.36	30.27	30.50	17,18	29.69	1
25-30 N	75-80 W	29.93	30.01	29.85	30.09	13	29.70	3
25-30 N	60-65 W	30.02	30.04	30.06	30.19	23	29.67	12
25-30 N	35-40 W	30.09	30.20	30.17	30.29	11	29.94	3
20-25 N	90-95 W	29.91	29.84	30.00	30.06	23	29.45	17
15-20 N	80-85 W	29.83	29.77	29.81	29.90	7,23	29.30	14
15-20 N	25-30 W	29.96	30.04	29.98	30.10	14	29.90	2,3

* Includes last 11 days of the month.

The mean and extreme values presented in the above table are based on the daily pressure values determined by interpolation of each square on the MS. daily synoptic charts of the North Atlantic compiled by the Marine Section of the Weather Bureau.

GALES.

The number of gales reported during the month varied considerably, as compared with the normal, over different parts of the ocean. Winds of gale force were comparatively frequent in the area between the 45th and 55th parallels and the 15th and 45th meridians, where they were reported on from 3 to 11 days, which was considerably above the normal. The number of days with gales in the Gulf of Mexico and West Indies waters was also above normal; while south of the 45th parallel and east of the 70th meridian the number of gales was less than usual.

From October 1 to 5 a well-developed LOW remained nearly stationary between the 48th and 58th parallels and the 20th and 40th meridians, its movements from day to day between these limits being slight and irregular. This disturbance attained its greatest intensity on the 2d and 3d, the lowest barometric reading being 29.10 inches on both of these dates. No heavy winds were reported near the center, although on the 3d vessels near latitude 38° N., longitude 52° W., encountered northerly gales of from 50 to 65 miles an hour.

On the 3d a LOW (*I* on Chart IX) was central near latitude 30° N., longitude 75° W. Vessels off the coast a short distance south of Hatteras reported northeasterly gales of from 40 to 55 miles an hour, although the storm area was limited. This disturbance moved slowly westward and on the 4th the center was near latitude 30°, longitude 79°, where it curved sharply toward the south, and on the 5th was about midway between Swan Island and the Isle of Pines. Light and moderate winds prevailed.

From the 6th to the 9th there were a number of depressions of varying intensities scattered over the ocean, but no specially heavy winds were reported.

Mr. R. H. Weightman, in a paper on hurricanes of 1916 (MONTHLY WEATHER REVIEW, December, 1916, 44:686-688), plotted and described two storm tracks that are here shown on Chart IX as *II* and *III*. Low *II* was so far south that its position could not be located on Chart IX until October 10, when its center was about 150 miles northeast of San Juan, Porto Rico. One vessel near the center reported a southeasterly gale of 55 miles an hour, but no heavy winds were reported west of the 70th meridian. This disturbance moved slowly toward the north, developing into a severe hurricane. On the morning of the 11th, when its center was near latitude 24°, longitude 64°, the barometer reading was 28.91 inches, and one vessel in latitude 25° 18′ N., longitude 63° 13′ W., reported a minimum reading of 28.38 inches at 4 p. m. on October 11 with a southwest wind of over 90 miles an hour. This storm continued its northerly course with a comparatively uniform rate of translation, and on the 12th was central near latitude 28°, longitude 63°. Its intensity had apparently decreased slightly since the previous day although winds of gale force still prevailed in the northern quadrants, but no reports were received from the region between the 23d and 30th parallels and the 50th and 80th meridians.

On October 12 LOW *III*, of slight intensity and limited extent, surrounded the island of Jamaica; the lowest barometer reading was 29.70 inches, and the winds were light to moderate. On the 13th LOW *II* had moved to near latitude 34°, longitude 59°, and its pressure had risen to a lowest reading of 29.99 inches, although one vessel near the center reported a strong northerly gale, while three other observers in the same locality recorded moderate winds. On the same day the center of *III* was near latitude 16°, longitude 80°, conditions of wind and weather having changed but little since the 12th. There was also a severe disturbance in northern waters, as one vessel near latitude 49° N., longitude 40° W., recorded a barometric reading of 28.90 inches, with a southwesterly gale of 65 miles an hour. Low *II* moved rapidly northward, and on the 14th was in the vicinity of Nova Scotia, where the minimum barometric reading was 29.50 inches, moderate gales prevailing in the southeast quadrants. Low *III* continued its westerly movement, increasing in intensity, and on the 14th northeasterly gales of hurricane force raged over the region between Cuba and Central America. The northern disturbance (LOW *II*) traveled speedily toward the northeast, and on the 14th the center was near latitude 59° N., longitude 8° W., where the barometer was 28.80 inches. On the same date a HIGH, with a crest of 30.44 inches, existed over the Azores, and the steep gradient between the two areas was accompanied by unusually heavy westerly and northwesterly winds in the intermediate territory, velocities of from 40 to 65 miles an hour being reported. By October 15 LOW *II* had apparently moved to Labrador, although its exact location could not be determined for lack of observations.

Low *III* continued its westward course, and on the 15th was near the northeast coast of Yucatan, Mexico; winds of hurricane force, accompanied by torrential rains, were still raging over a limited territory. On the 16th the center of the disturbance was over the northwest coast of Yucatan, the weather conditions having moderated since the previous day, although moderate gales were still reported. During the next 24 hours the northerly drift of this disturbance was slight, the wind velocities remaining practically constant, and the barometer having fallen slightly. The rate of translation then increased, and on the 18th the storm was central about 100 miles east of New Orleans, moderate gales still prevailing.

On Chart III (XLIV—127) Tracks of Centers of Low Areas for October, 1916, a LOW (*IV* on Chart IX) is shown on the morning of October 15 near Edmonton, Alberta. By the morning of the 17th this disturbance had moved to near Quebec, where the barometer reading was 29.36 inches, accompanied by moderate winds. The LOW continued its course toward the northeast, and on the 18th the center was near latitude 54°, longitude 46°; strong westerly and southwesterly winds of 40 to 65 miles occurred in the southeast quadrant. On the 19th the center was in the vicinity of latitude 57°, longitude 28°, with a barometer reading of 29.55 inches. On the same date a HIGH, with a crest of 30.68 inches, was central off the east coast of Nova Scotia, and the steep gradient caused strong northwest gales, attended by hail, over a portion of the region between the two areas, where the barometer readings ranged from 29.97 inches to 30.11 inches. From the 20th to the 23d the path of LOW *IV* eastward was irregular, as shown on Chart IX, and no specially heavy winds were reported.

On the 23d a fifth LOW, with a minimum reading of 29.20 inches, was central near latitude 58°, longitude 27°, strong northwesterly gales prevailing over a limited territory in the southwest quadrant. On the 24th this LOW was near latitude 58°, longitude 27°, and had increased in intensity since the previous day, as the barometer now read 28.70 inches. At the same time a HIGH had its crest near St. Johns, N. F., where the barometer reading was 30.54 inches. Violent northwesterly gales, accompanied by hail and rain, swept a large area between the centers. The LOW drifted slowly toward the east, and on the 25th was near latitude 56° N., longitude 10° W., with practically the same intensity, and northwesterly gales attended by hail still continued east of the 35th meridian over the steamer lanes. During the next 24 hours this disturbance moved about 200 miles toward the north, decreasing slightly in intensity, although on the 26th moderate to strong gales still prevailed near its center and between the 30th and 45th meridians. On the 27th it covered the southern part of the Irish Sea, had decreased in extent, and increased slightly in intensity since the previous day. Vessels off the south coast of Ireland encountered northerly gales of from 50 to 65 miles an hour, while over the remainder of the ocean moderate winds were the rule, the highest velocity recorded being 40 miles an hour within a limited territory between the 35th and 45th meridians. From the 28th to the 30th the LOW remained nearly stationary in the vicinity of Great Britain. On the 29th reports were received from vessels in widely scattered positions along the steamer routes, denoting winds of gale force, while between the 30th and 40th meridians only light to moderate winds were encountered. The conditions on the 30th and 31st did not differ much from those of the 29th, although the storm area had increased somewhat in extent.

From the 23d to the 30th a LOW of slight intensity occupied the western division of the Caribbean Sea between Cuba and Central America, remaining nearly stationary during that period. As a rule it was not attended by winds of high velocities, although one vessel reported a southeasterly gale of about 50 miles an hour on October 25 in the vicinity of latitude 23° longitude 75° W.

TEMPERATURE.

The temperature of the air during October, 1916, was somewhat below the normal over a large portion of the ocean, but it was slightly above in the waters adjacent to the European coast, and over the greater part of the region between the 30th and 40th parallels in the vicinity of the American coast. North of the 40th parallel the positive departures ranged from 2 to 5, while along the coast south of Georgia and in the Gulf of Mexico they were either zero or slightly negative.

The seasonal fall of temperature during the month was quite marked, especially in the higher latitudes, the average for the last decade being considerably below that of the first.

The following table gives the temperature departures for the month at a number of Canadian and United States Weather Bureau stations on the Atlantic and Gulf coasts.

	°F.		°F.
St. John's, N. F.	+1.1	Norfolk, Va.	+1.7
Sydney, C. B. I.	+3.7	Hatteras, N. C.	+0.5
Halifax, N. S.	+2.7	Charleston, S. C.	+0.3
Eastport, Me.	+1.8	Key West, Fla.	+0.6
Portland, Me.	+1.3	Tampa, Fla.	+2.4
Boston, Mass.	+3.2	Mobile, Ala.	+1.7
Nantucket, Mass.	+0.1	New Orleans, La.	+2.1
Block Island, R. I.	−0.2	Galveston, Tex.	+0.1
New York, N. Y.	+1.6	Corpus Christi, Tex.	+0.8

FOG.

The amount of fog reported during the month was less than usual over all parts of the North Atlantic; this was specially noticeable off the Banks of Newfoundland where the normal percentage ranges from 30 to 35, while during October, 1916, it was observed on two days only, a percentage of 6. For the month under discussion the greatest amount of fog occurred in the Gulf of St. Lawrence and off the Nantucket Shoals; it was observed on four days in both localities, a percentage of 13, while the normal percentage is from 10 to 20. There was practically no fog along the steamer lanes east of the 40th meridian.

HAIL.

The most frequent occurrence of hail was in the 5-degree square between latitudes 50°–55° and longitudes 30°–35°, where it was reported on the 24th, 25th, and 28th. In no other square was it observed on more than two days, and none was reported west of the 50th meridian.

Winds of 50 mis./hr. (22.4 m./sec.), or over, during October, 1917.

Station.	Date.	Velocity.	Direction.	Station.	Date.	Velocity.	Direction.
		Mis./hr.				Mis./hr.	
Atlanta, Ga.	30	52	w.	Louisville, Ky.	26	52	sw.
Block Island, R. I.	24	70	e.	Do.	29	50	s.
Do.	30	60	w.	Nantucket, Mass.	24	54	e.
Buffalo, N. Y.	3	50	sw.	Do.	30	68	sw.
Do.	5	50	w.	New York, N. Y.	12	56	se.
Do.	12	72	sw.	Do.	24	51	n.
Do.	13	62	sw.	Do.	27	54	sw.
Do.	14	54	sw.	Do.	30	62	s.
Do.	26	56	sw.	Norfolk, Va.	30	55	nw.
Do.	27	58	sw.	North Head, Wash.	27	56	nw.
Do.	28	58	sw.	Pierre, S. Dak.	22	52	nw.
Do.	30	76	sw.	Providence, R. I.	30	55	w.
Burlington, Vt.	19	50	s.	Richmond, Va.	5	52	nw.
Cheyenne, Wyo.	17	50	w.	Salt Lake City, Utah.	27	52	n.
Do.	19	54	w.	Sandy Hook, N. J.	24	68	e.
Do.	21	51	w.	Do.	27	55	s.
Do.	27	55	w.	Do.	30	64	s.
Devils Lake, N. Dak.	22	50	n.	Sioux City, Iowa.	11	55	nw.
Duluth, Minn.	11	54	nw.	Do.	18	52	nw.
Eastport, Me.	24	56	e.	Do.	22	57	nw.
Do.	25	54	e.	Tatoosh Island, Wash.	1	54	s.
Do.	30	56	se.	Do.	2	52	s.
Hatteras, N. C.	30	56	s.				

CONDENSED CLIMATOLOGICAL SUMMARY.

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, September, 1917.

Section.	Temperature. Section average.	Temperature. Departure from the normal.	Monthly extremes. Station.	Highest.	Date.	Station.	Lowest.	Date.	Precipitation. Section average.	Departure from the normal.	Greatest monthly. Station.	Amount.	Least monthly. Station.	Amount.
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	58.4	−5.7	Livingston	95	5	St. Bernard	22	31	1.47	−1.00	Gadsden	3.54	Livingston	0.04
Arizona	63.7	+2.9	Sentinel	116	5	Alpine	10	20	0.04	−0.73	Holbrook	1.48	64 stations	0.00
Arkansas	56.6	−5.3	Hot Springs	99	4	2 stations	12	30	1.89	−0.88	Junction	4.12	Fort Smith	0.20
California	64.4	+3.3	Needles	112	5	Bridgeport	5	18	0.01	−1.44	Mill Creek (No. 2)	0.24	160 stations	0
Colorado	44.9	−1.5	Holly	93	6	Westcliffe	−20	28	0.55	−0.75	Wortman	2.57	4 stations	0.00
Florida	71.2	−2.4	2 stations	94	9†	Bristol	25	25	2.82	−1.71	Pinellas Park	10.16	Wausau	0.06
Georgia	59.9	−4.3	2 stations	92	19†	Tate	21	31	1.22	−1.59	Washington	3.90	Brunswick	0.01
Hawaii (Sept.)	74.9	+0.4	Mahukona, Hawaii	96	28	Glenwood	50	11	2.81	−3.06	Kawailki, Oahu	9.81	2 stations	0.00
Idaho	47.4	+1.0	Weiser	90	3	Big Springs	−16	29	0.20	−1.06	French Gulch	2.90	28 stations	0.00
Illinois	46.7	−8.3	2 stations	89	15	Joliet	15	31	2.91	+0.53	Casey	5.85	Pearl	0.60
Indiana	46.9	−7.4	Rome	89	17	Tab	16	30	4.72	+2.25	Kokomo	10.91	Mount Vernon	2.43
Iowa	42.9	−7.9	Mason City	85	2	Galva	0	30	1.41	−1.05	Davenport	4.00	Rock Rapids	0.15
Kansas	51.0	−5.8	Liberal	99	1	2 stations	1	23†	0.49	−1.54	Leavenworth	1.69	7 stations	T.
Kentucky	51.1	−6.6	2 stations	90	17	4 stations	20	24	3.18	+0.90	London	5.54	Marion	1.23
Louisiana	62.8	−4.7	Angola	97	5	Kelly (near)	21	31	1.18	−1.60	Opelousas	3.00	2 stations	0.00
Maryland-Delaware	50.9	−5.3	Westernport, Md	87	3	2 stations, Md	18	21	5.83	+2.63	Cambridge, Md	9.55	Westernport, Md	2.01
Michigan	41.1	−7.2	Croton	74	4	2 stations	8	24	3.79	+1.17	Ann Arbor	7.09	Wellston	1.64
Minnesota	36.4	−9.6	Ada	77	1	Grand Rapids	−10	23	1.64	−0.58	Winona	3.48	Luverne	0.20
Mississippi	59.2	−5.7	2 stations	95	5	Duck Hill	21	24	1.49	−0.82	Water Valley	4.00	McNeill	0.22
Missouri	49.8	−7.4	Caruthersville	93	16	Maryville	12	30†	1.16	−1.49	Patton (near)	2.50	Crocker	0.04
Montana	42.8	−1.0	3 stations	88	3	Bowen	−17	29	0.71	−0.37	Hat Creek	3.29	Mildred	T.
Nebraska	45.3	−5.5	Seward	92	2	Alliance	−5	29	0.36	−1.19	Syracuse	1.42	2 stations	0.00
Nevada	53.5	+3.4	Logandale	101	4	Tecoma	−1	29	T.	−0.59	Goldfield	0.07	38 stations	0.00
New England	46.9	−1.9	Patten, Me	81	1	Chelsea, Vt	19	23	5.81	+2.16	Canton, Conn	9.21	New London, Conn	3.49
New Jersey	50.7	−3.4	Indian Mills	84	5	Culvers Lake	17	31	6.99	+3.24	Lakewood	9.74	Lambertville	4.28
New Mexico	53.5	+0.4	Artesia	96	6	3 stations	−1	29	0.09	−1.01	Mimbres	0.78	64 stations	0.00
New York	45.5	−4.6	Scarsdale	80	14	Indian Lake	15	21	6.44	+2.90	Adams Center	11.93	Mohonk Lake	3.16
North Carolina	55.4	−4.2	5 stations	88	16	2 stations	15	31	2.81	−0.66	Rock House	5.76	Wilmington	0.34
North Dakota	34.7	−9.1	2 stations	82	1†	Marstonmoor	−4	23	0.77	−0.23	Donnybrook	2.15	Mandan	0.04
Ohio	46.7	−6.6	Portsmouth	87	18	Montpelier	18	24	4.81	+2.58	Summerfield	8.05	McArthur	2.03
Oklahoma	56.9	−4.8	2 stations	100	4†	Hurley	9	29	0.14	−2.53	Hurley	0.84	6 stations	0.00
Oregon	53.0	+2.1	Wedderburn	98	3	Crescent	−1	28	0.10	−2.52	Government Camp	1.90	80 stations	0.00
Pennsylvania	47.2	−4.9	Derry	84	17	Mount Pocono	12	31	6.38	+3.01	Edinboro	9.80	Elk Lick	3.33
Porto Rico	77.7	−0.5	3 stations	96	5†	2 stations	55	15†	6.02	−2.92	Las Marias	17.05	Hac. Isidoro	0.37
South Carolina	59.3	−3.8	Little Mountain	90	29	Mountain Rest	22	31	1.50	−1.62	Catawba	4.03	2 stations	T.
South Dakota	41.1	−7.6	Dowling	86	1	Oelrichs	−5	29	0.35	−1.28	Deadwood	2.70	3 stations	0.00
Tennessee	53.2	−5.9	Bolivar	90	18	Erasmus	15	31	2.53	−0.10	Cookeville	4.49	New River	1.35
Texas	64.8	−2.3	Dublin	105	4	2 stations	11	29	0.33	−2.29	Alvin	2.34	42 stations	0.00
Utah	50.2	+1.6	2 stations	90	4†	Blacks Fork	−8	29	0.08	−1.02	Silver Lake	0.96	44 stations	0.00
Virginia	51.9	−4.8	2 stations	88	2†	Rocky Mount	15	31	3.90	+0.62	Mount Weather	7.32	Kindrick	1.12
Washington	51.6	+1.9	3 stations	90	4†	Newport	6	28	0.64	−1.89	Forks	5.79	29 stations	0.00
West Virginia	49.2	−5.8	Romney	89	15	Marlinton	16	31	4.35	+1.64	Wheeling	6.50	Camden-on-Gauley	1.18
Wisconsin	38.3	−9.8	Mount Horeb	78	5	Mauston	8	31	3.27	+0.81	Waukesha	6.00	Florence	0.45
Wyoming	40.3	−2.0	Thermopolis	92	3	Soda Butte	−33	29	0.74	−0.45	Sand Lake	3.22	Lovell	0.00

† Other dates also.

DESCRIPTION OF TABLES AND CHARTS.

(See MONTHLY WEATHER REVIEW, July, 1917, p. 388.)

TABLE I.—*Climatological data for Weather Bureau Stations, October, 1917.*

Districts and stations.	Elevation of instruments: Barometer above sealevel.	Elevation of instruments: Thermometer above ground.	Elevation of instruments: Anemometer above ground.	Pressure: Station, reduced to mean of 24 hours.	Pressure: Sealevel, reduced to mean of 24 hours.	Pressure: Departure from normal.	Temperature of the air: Mean max. + mean min. ÷ 2.	Temperature of the air: Departure from normal.	Temperature of the air: Maximum.	Temperature of the air: Date.	Temperature of the air: Mean maximum.	Temperature of the air: Minimum.	Temperature of the air: Date.	Temperature of the air: Mean minimum.	Temperature of the air: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dewpoint.	Mean relative humidity.	Precipitation: Total.	Precipitation: Departure from normal.	Precipitation: Days with 0.01 inch or more.	Wind: Total movement.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour.	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F		°F	°F.		°F	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
New England.							**48.5**	**−1.8**										**81**	**4.83**	**+1.2**										**5.7**		
Eastport	76	67	85	29.95	30.04	+0.04	46.2	−0.4	61	1	52	32	18	40	19	44	42	88	4.01	+0.2	14	9,742	s.	56	e.	24	10	9	12	5.9		
Greenville	1,070	6		28.85	30.03		42.1		61	30	50	27	18	35	32				6.40		19						5	11	15		1.0	
Portland, Me	103	82	117	29.94	30.06	+ .02	47.0	−2.1	63	27	54	33	12	40	22	43	40	79	4.09	+0.4	16	8,319	s.	46	ne.	24	13	3	15	5.5		
Concord	288	70	79	29.74	30.06	+ .01	46.8	−1.9	69	19	56	26	12	37	32				3.54	+0.3	16	4,185	se.	31	e.	24	14	4	13	5.0		
Burlington	404	11	48	29.57	30.01	− .03	44.8	−2.1	69	19	52	28	23	38	27				5.76	+2.6	18	8,826	s.	50	s.	19	3	6	22	7.8	T.	
Northfield	876	12	60		30.04	.00	42.3	−1.3	66	19		22	23		31				5.82	+3.3	19						19	2	3		T.	
Boston	125	115	188	29.92	30.06	+ .01	51.9	−0.4	71	19	60	37	12	44	28	47	43	77	5.33	+1.5	14	8,108	sw.	48	ne.	24	11	6	14	5.5	T.	
Nantucket	12	14	90	30.04	30.05	.00	52.6	−1.9	64	1	58	40	12	47	20	50	48	86	4.59	+1.2	12	12,459	sw.	68	sw.	30	6	15	10	6.0		
Block Island	26	11	46	30.02	30.06	+ .01	51.7	−3.6	65	4	57	40	31	46	19	49	47	83	5.02	+0.9	9	13,918	nw.	70	e.	24	12	5	14	5.6		
Narragansett Pier		9					49.5		66	16	58	30	31	41	25				5.52		12		w.				19	6	6			
Providence	160	215	251	29.88	30.06	+ .01	50.0	−2.2	68	4	58	21	34	42	28	46	42	79	5.02	+1.2	14	9,658	nw.	55	w.	30	13	10	8	4.8		
Hartford	159	122	140	29.88	30.06	.00	49.6	−1.6	70	19	58	31	21	41	29	45	42	80	5.30	+1.4	13	5,885	s.	39	sw.	30	13	7	11	5.0		
New Haven	106	117	155	29.95	30.07	+ .01	50.7	−2.1	70	4	59	32	31	42	26	46	42	74	4.68	+0.8	12	7,768	n.	46	s.	30	12	8	11	5.2		
Middle Atlantic States.							**51.6**	**−4.1**										**75**	**5.00**	**+1.8**										**4.9**		
Albany	97	102	115	29.93	30.04	−0.02	48.2	−2.2	71	19	56	32	23	40	32	43	39	74	5.63	+2.6	14	6,093	s.	33	s.	30	9	6	16	6.4		
Binghamton	871	10	69	29.08	30.02	− .04	45.8	−3.4	67	3	55	26	21	37	31				5.95	+2.8	15	4,207	nw.	27	ne.	24	7	5	19	7.1	0.2	
New York	314	414	454	29.71	30.05	− .01	52.0	−3.6	74	5	59	29	31	45	30	46	41	72	5.68	+2.0	10	13,791	nw.	62	s.	30	10	8	13	5.6		
Harrisburg	374	94	104	29.66	30.07	− .01	49.7	−4.3	71	15	59	28	31	41	36	43	38	71	5.28	+2.3	11	4,726	nw.	36	sw.	30	9	11	11	5.4	T.	
Philadelphia	117	123	190	29.95	30.08	+ .01	53.8	−2.5	78	5	62	32	31	45	29	47	42	71	6.04	+2.9	10	7,964	nw.	38	ne.	24	13	9	9	4.9		
Reading	325	81	98	29.71	30.07		50.4		74	19	60	29	31	41	38	45	40	72	5.07	+1.8	9	5,551	nw.	32	ne.	24	12	8	11	5.4	T.	
Scranton	805	111	119	29.18	30.05	− .02	47.4	−4.0	69	19	57	29	10	38	35	43	39	78	6.07	+3.2	12	5,791	sw.	37	sw.	27	6	7	18	7.1	0.2	
Atlantic City	52	37	48	30.01	30.07	.00	52.8	−4.6	75	4	60	29	31	46	30	49	46	76	5.97	+2.7	12	6,671	nw.	38	se.	24	18	4	9	4.0		
Cape May	18	13	49	30.08	30.10	+ .03	53.7	−5.9	77	4	61	32	31	46	25				7.51	+4.2	11	7,405	s.	42	nw.	30	19	7	5	3.8		
Sandy Hook	22	10	57	30.03	30.05		52.6		70	4	59	33	31	46	28	49	45	79	5.52		10	13,788	s.	68	e.	24	10	16	5	4.5		
Trenton	190	159	183	29.85	30.05		51.6		79	5	61	29	31	42	35	46	42	77	5.30	+1.9	10	8,958	w.	48	ne.	24	12	11	8	4.9		
Baltimore	123	100	113	29.94	30.07	− .01	52.6	−4.9	76	15	62	30	31	44	34	47	41	69	5.01	+2.0	12	5,209	nw.	28	se.	19	15	7	9	4.4		
Washington	112	62	85	29.94	30.06	− .02	52.0	−4.6	79	19	63	26	31	41	35	46	41	76	4.81	+1.7	13	5,101	nw.	40	nw.	30	17	6	8	4.3	T.	
Lynchburg	681	153	188	29.33	30.08	− .01	53.0	−3.9	83	16	66	28	31	40	39	45	41	72	2.24	−1.1	8	4,498	n.	35	nw.	30	17	10	4	4.3	T.	
Norfolk	91	170	205	29.98	30.08	+ .01	58.2	−3.1	81	5	67	37	31	49	32	51	47	73	2.89	−1.0	12	9,938	s.	55	nw.	30	19	8	4	2.9		
Richmond	144	11	52	29.92	30.08	.00	54.8	−5.0	83	5	67	28	31	43	35	48	45	78	3.78	+0.5	10	6,024	s.	52	nw.	5	14	11	6	4.1		
Wytheville	2,293	49	55	27.68	30.09	.00	47.8	−5.8	74	16	60	22	31	35	39	42	40	82	2.82	−0.3	10	4,908	w.	36	w.	5	17	8	6	3.6	2.0	
South Atlantic States.							**60.5**	**−3.2**										**75**	**1.43**	**−2.5**										**3.2**		
Asheville	2,255	70	84	27.73	30.12	+0.03	50.0	−5.3	78	5	62	23	31	38	37	43	40	77	1.81	−1.1	7	6,520	nw.	38	nw.	30	17	4	10	4.0	T.	
Charlotte	773	153	161	29.24	30.08	.00	57.0	−4.1	83	5	68	31	24	46	29	49	44	67	1.95	−1.2	5	7,606	ne.	39	nw.	30	19	7	5	2.8		
Hatteras	11	12	50	30.07	30.06	.00	63.2	−2.8	78	29	70	45	31	57	29	58	55	79	1.23	−4.8	6	10,587	ne.	56	s.	30	22	3	6	3.2		
Manteo	12	5	42				58.0		80	6	67	35	26	49					3.40	−2.6	3		ne.				21	3	7			
Raleigh	376	103	110	29.67	30.08	+ .01	57.0	−3.5	84	16	69	30	31	45	36	50	46	72	4.30	+0.8	6	5,769	ne.	38	w.	30	17	11	3	3.4		
Wilmington	78	81	91	29.99	30.08	+ .02	60.7	−2.6	83	16	71	33	31	50	34	54	51	78	0.34	−3.4	5	5,627	n.	38	w.	30	21	7	3	2.5		
Charleston	48	11	92	30.02	30.07	+ .01	63.7	−3.4	84	5	72	39	24	56	25	58	54	77	0.33	−3.6	2	7,601	n.	36	nw.	30	21	5	5	2.8		
Columbia, S. C.	351	41	57	29.70	30.09	+ .02	60.8	−3.2	84	19	72	34	25	50	34	51	46	67	0.81	−2.0	6	5,145	ne.	31	sw.	30	23	7	1	2.1		
Augusta	180	62	77	29.88	30.08	+ .01	61.0	−2.6	85	5	74	33	31	48	35	54	50	80	0.60	−1.7	4	3,819	nw.	24	nw.	30	24	3	4	2.2		
Savannah	65	150	194	30.00	30.07	+ .02	64.4	−1.9	85	5	74	39	31	55	28	58	55	79	0.54	−3.0	4	7,932	ne.	42	nw.	30	13	13	5	3.8		
Jacksonville	43	200	245	30.00	30.05	+ .03	67.0	−2.6	85	19	74	41	31	60	27	61	57	76	0.38	−4.7	6	8,552	ne.	34	nw.	30	8	17	6	5.0		
Florida Peninsula.							**76.5**	**+0.1**										**78**	**3.28**	**−3.0**										**5.8**		
Key West	22	10	64	29.94	29.96	+0.02	79.4	+0.7	87	17	84	70	3	75	13	73	71	79	3.67	−1.7	18	5,945	se.	24	n.	6	8	13	10	6.1		
Miami	25	71	79	29.96	29.99		77.4	−0.4	87	30	82	63	25	73	16	72	70	80	2.11	−8.4	13	5,816	e.	23	ne.	2	5	13	13	6.3		
Sand Key	23	39	72	29.92	29.95	+ .01	78.6		86	21	81	71	6	76	10	74	72	78	3.54		16	8,952	e.	38	se.	14	7	15	9	5.8		
Tampa	35	79	96	29.98	30.02	+ .04	72.6	0.0	88	28	81	48	25	64	26	65	62	77	3.99	+1.0	7	4,662	ne.	20	nw.	30	14	10	7	4.9		
East Gulf States.							**60.7**	**−4.6**										**69**	**0.99**	**−1.8**										**2.4**		
Atlanta	1,174	190	216	28.85	30.10	+0.03	56.6	−5.8	82	5	68	28	24	46	31	49	44	67	1.60	−0.7	5	8,649	w.	52	w.	30	24	2	5	2.5		
Macon	370	78	87	29.69	30.09	+ .02	59.6	−4.1	85	5	72	31	25	47	33	52	48	74	0.74	−1.4	6	4,043	nw.	25	nw.	30	22	5	4	2.6		
Thomasville	273	49	58	29.76	30.06	+ .02	64.4	−3.8	87	28	76	33	31	52	35	55	51	71	0.35	−3.1	4	3,006	n.	15	nw.	30	19	5	7	3.6		
Pensacola	56	149	185	30.01	30.07	+ .04	63.8	−5.6	80	8	72	37	31	56	26	56	50	66	0.75	−3.3	5	9,792	n.	34	n.	30	22	5	4	2.6		
Anniston	741	9	57	29.31	30.11	+ .04	55.6	−3.2	85	5	70	26	31	41	38				1.38	−1.0	4	3,876	se.	20	nw.	19	25	3	3	2.0		
Birmingham	700	11	48	29.34	30.11	+ .04	57.9	−6.5	86	5	71	29	31	45	39	49	43	68	1.83	−0.5	5	4,813	n.	25	s.	29	24	4	3	2.1		
Mobile	57	125	161	30.01	30.07	+ .03	63.7	−3.4	85	16	74	36	31	53	29	56	51	72	0.70	−2.5	5	7,242	n.	34	nw.	29	21	8	2	2.6		
Montgomery	223	100	112	29.84	30.09	+ .03	60.4	−5.3	86	5	72	34	31	48	33	52	47	67	0.82	−1.6	3	4,547	n.	24	nw.	29	24	3	4	2.2		
Corinth	469	6																														
Jackson	304	5					59.7		94	5	75	26	31	44	46				1.16		4		se.				20	8	3			
Meridian	375	85	93	29.69	30.09	+ .03	58.3	−4.7	90	5	72	28	31	44	43	50	44	68	0.46	−2.2	6	3,696	n.	26	nw.	29	24	4	3	1.9		
Vicksburg	247	65	74	29.82	30.11	+ .05	60.6	−4.7	86	5	72	31	30	49	44	52	46	66	1.55	−1.2	5	4,954	se.	35	nw.	29	24	4	3	1.9		
New Orleans	51	76	84	30.01	30.07	+ .04	66.4	−3.1	87	18	75	40	30	58	37	58	52	68	0.71	−2.2	5	5,164	ne.	26	n.	19	20	9	2	2.4		
West Gulf States.							**63.5**	**−3.1**										**62**	**0.88**	**−1.9**										**2.4**		
Shreveport	249	77	93	29.81	30.09	+0.04	61.6	−4.0	89	7	75	29	30	48	35	51	43	59	2.13	−1.0	4	5,357	se.	30	se.	25	23	4	4	2.3		
Bentonville	1,303	11	44	28.68	30.03	+ .01	52.2	−5.8	86	16	66	18	30	39	38				0.70	−2.1	6	4,722	nw.	26	s.	28	21	3	7	3.4	T.	
Fort Smith	457	79	94	29.57	30.06	+ .01	57.2	−4.5	90	16	71	22	30	44	37	47	39	58	0.20	−2.6	4	6,521	e.	39	nw.	25	20	8	3	2.8		
Little Rock	357	139	147	29.69	30.07	+ .01	57.9	−5.0	85	3	70	27	30	46	41	48	40	58	2.03	−0.5	5	7,325	s.	46	e.	25	20	5	6	3.5		
Brownsville	57	4	26				73.2		96	18	86	44	30	61	36				T.		0		ne.									
Corpus Christi	20	69	77	30.04	30.06	+ .06	70.2	−2.4	91	5	78	41	30	62	25	63	59	74	0.44	−1.6	3	7,926	se.	37	n.	29	18	10	3	3.4		
Dallas	512	109	117	29.53	30.08		63.7		97	7	78	26	30	50	37				0.11		2	7,331	s.	42	s.	28	21	8	2	2.4		
Fort Worth	670	106	114	29.33	30.05	+ .02	64.0	−2.3	97	7	78	24	30	50	42	52	45	59	0.17	−2.3	1	8,723	s.	45	nw.	28	24	7	0	1.7		
Galveston	54	106	114	30.02	30.08	+ .05	68.6	−3.8	87	5	74	41	30	63	28	61	56	69	1.49	−2.7	5	8,547	s.	40	n.	18	24	3	4	2.1		
Houston	138	111	121	29.93	30.07		67.8	−2.1	94	5	80	33	30	56	34				0.32		2	6,165	se.	29	n.	29	24	3	4	2.5		
Palestine	510	64	72	29.53	30.07	+ .04	64.4	−1.8	95	7	77	27	30	51	37	54	49	66	0.31	−3.3	3	5,888	s.	36	s.	25	26	3	2	1.8		
Port Arthur	34	58	66	30.02	30.06		65.0		88	5	75	32	30	55	33	59	56	85	1.35		5	6,672	e.	35	n.	25	24	4	3	2.2		
San Antonio	701	119	132	29.33	30.05	+ .04	68.6	−0.6	95	5	82	32	30	56	34	55	46	54	0.48	−1.0	2	5,780	s.	35	n.	29	26	5	0	1.4		
Taylor	582	55	63	29.49	30.10	+ .08	66.1	−2.2	94	7	80	27	30	52	37				0.74	−1.8	2	7,084	s.	38	sw.	25	26	3	2	1.7		

TABLE I.—*Climatological data for Weather Bureau Stations, October, 1917*—Continued.

Districts and stations.	Elevation of instruments: Barometer above sealevel.	Thermometer above ground.	Anemometer above ground.	Pressure: Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Temperature of the air: Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dewpoint.	Mean relative humidity.	Precipitation: Total.	Departure from normal.	Days with 0.01 inch or more.	Wind: Total movement.	Prevailing direction.	Maximum velocity: Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F		°F	°F.		°F	°F.	°F.	°F.	%	In.	In.		Miles.								0-10	In.	In.
Ohio Valley and Tennessee.							50.4	−6.2										70	3.12	+.60										5.5		
Chattanooga	762	189	213	29.29	30.11	+0.02	54.6	−6.2	80	17	66	26	31	43	34	46	41	67	1.94	−0.9	4	5,620	nw.	38	sw.	29	21	6	4	3.2	T.	....
Knoxville	996	93	100	29.03	30.09	.00	52.4	−5.7	82	17	64	28	24	40	38	46	41	73	3.54	+0.9	7	4,272	sw.	36	s.	29	17	9	5	3.5	....	....
Memphis	399	76	97	29.68	30.11	+ .04	56.6	−5.9	84	17	68	28	30	46	37	47	39	58	1.72	−1.0	7	7,082	s.	44	nw.	29	22	4	5	2.5	....	....
Nashville	546	168	191	......	30.11	+ .03	53.2	−7.1	82	17	65	30	30	42	39	....	....	....	2.25	−0.2	7	7,498	s.	38	s.	26	17	9	5	....	....	....
Lexington	989	193	230	29.00	30.09	+ .01	50.0	−6.5	82	17	60	25	30	40	44	....	....	....	2.36	+0.1	11	10,537	se.	48	sw.	29	9	11	11	5.5	0.2	....
Louisville	525	219	255	29.50	30.08	.00	50.8	−7.6	83	17	60	27	30	41	40	43	36	63	2.46	−0.2	9	9,801	se.	52	sw.	28	8	11	12	5.5	T.	....
Evansville	431	139	175	29.59	30.06	− .02	51.5	−6.5	85	17	61	29	30	42	37	44	38	64	3.05	0.0	7	8,924	s.	46	nw.	11	7	15	9	5.3	0.2	....
Indianapolis	822	194	230	29.14	30.05	− .02	46.9	−8.1	78	17	56	24	30	38	34	41	35	66	3.96	+1.2	11	9,606	s.	40	w.	26	9	6	16	6.5	0.4	....
Terre Haute	575	96	129	29.40	30.02	......	48.0	......	82	15	58	25	30	38	38	42	36	70	4.35	......	9	8,104	nw.	44	sw.	18	5	13	13	6.5	0.6	....
Cincinnati	628	11	51	29.37	30.06	− .02	48.0	−5.0	79	18	58	26	30	38	42	42	36	70	2.79	+0.5	12	5,887	sw.	35	sw.	26	8	8	15	6.4	T.	....
Columbus	824	173	222	29.16	30.05	− .03	47.5	−6.6	76	18	57	26	30	38	41	41	36	68	3.05	+0.7	14	9,552	nw.	48	nw.	12	5	8	18	7.1	0.6	T.
Dayton	899	181	216	29.06	30.03	......	47.4	−6.7	78	17	56	26	30	38	37	42	38	74	3.51	+1.1	14	8,613	sw.	41	sw.	26	8	9	14	6.2	0.4	T.
Pittsburgh	842	353	410	29.14	30.05	− .03	48.9	−6.0	79	18	58	26	30	40	33	43	39	75	5.27	+2.9	16	8,849	sw.	45	w.	30	5	7	19	6.9	3.0	....
Elkins	1,940	41	50	28.00	30.09	− .01	47.2	−4.2	77	18	60	21	21	34	49	40	37	80	2.97	+0.6	14	3,514	w.	32	w.	30	6	14	11	6.1	4.8	....
Parkersburg	638	77	84	29.42	30.09	− .01	50.0	−4.6	81	17	60	29	30	40	37	44	40	77	4.77	+2.3	13	4,414	se.	28	s.	29	7	14	10	5.5	1.0	....
Lower Lake Region.							45.5	−6.4										76	5.54	+2.6										7.6		
Buffalo	767	247	280	29.16	30.00	−0.05	45.5	−6.0	75	18	52	28	31	39	30	42	38	80	6.90	+3.4	18	14,819	w.	76	sw.	30	1	9	21	7.7	4.5	4.0
Canton	448	10	61	29.49	29.98	......	42.8	−4.4	67	19	50	25	10	36	30	....	....	....	5.64	+2.3	20	8,834	sw.	47	sw.	19	4	6	21	7.9	0.1	T.
Oswego	335	76	91	29.62	30.00	− .05	46.6	−4.6	67	19	53	30	31	40	28	42	38	73	4.90	+1.6	18	8,659	s.	37	ne.	24	2	10	19	7.2	T.	
Rochester	523	97	113	29.44	30.02	− .03	45.8	−5.0	71	18	53	29	31	38	31	41	37	76	4.99	+2.1	18	6,713	sw.	38	sw.	30	3	6	22	8.0	T.	
Syracuse	597	97	113	29.37	30.02	− .04	46.2	−4.8	67	19	53	28	10	39	32	42	38	76	4.67	+1.5	17	9,607	s.	48	s.	19	2	10	19	7.5	T.	
Erie	714	130	166	29.23	30.01	− .04	46.2	−6.9	75	18	53	26	31	39	33	41	37	73	7.88	+4.1	21	12,822	s.	47	sw.	30	1	10	20	7.6	4.4	T.
Cleveland	762	190	201	29.19	30.03	− .03	46.5	−6.6	73	18	53	26	31	40	33	42	38	76	5.09	+2.4	17	11,219	s.	48	ne.	24	1	11	19	7.8	T.	
Sandusky	629	62	103	29.33	30.02	− .04	45.6	−8.3	71	18	53	25	30	39	30	41	37	76	6.22	+3.8	16	10,401	sw.	40	sw.	29	2	10	17	7.6	1.6	T.
Toledo	628	208	243	29.33	30.02	− .03	45.5	−7.1	68	18	53	26	30	38	29	41	37	76	5.51	+3.2	19	11,027	sw.	45	sw.	26	4	11	16	7.1	0.5	T.
Fort Wayne	856	113	124	29.10	30.03	......	44.2	−9.5	67	3	52	23	30	36	29	40	36	76	7.57	......	17	6,656	sw.	37	sw.	26	1	14	16	7.6	5.6	1.5
Detroit	730	218	245	29.20	30.01	− .04	44.9	−6.8	67	18	51	24	30	38	26	41	37	78	3.62	+1.2	18	9,515	w.	48	sw.	26	3	10	18	7.7	T.	T.
Upper Lake Region.							40.3	−7.3										79	3.60	+0.8										7.9		
Alpena	609	13	92	29.30	29.97	−0.06	40.4	−5.5	66	18	47	27	25	34	21	38	35	82	4.14	+0.7	19	9,538	nw.	43	se.	17	1	16	14	7.0	1.7	T.
Escanaba	612	54	60	29.29	29.97	− .04	38.8	−6.3	64	2	45	22	24	32	26	36	32	78	3.16	+0.1	16	8,512	nw.	35	ne.	5	4	12	15	6.8	1.0	T.
Grand Haven	632	54	92	29.28	29.98	− .05	42.3	−7.9	62	18	48	28	30	36	22	39	35	75	4.48	+2.0	22	9,802	w.	48	sw.	26	4	4	23	7.8	1.4	0.5
Grand Rapids	707	70	87	29.21	29.99	− .05	42.9	−7.2	70	18	49	28	31	37	27	39	35	77	4.57	+2.0	21	4,854	w.	26	w.	26	1	7	23	8.5	3.0	1.0
Houghton	684	62	99	29.19	29.93	− .07	37.6	−7.5	57	2	42	22	24	33	21	....	....	....	4.32	+1.1	22	8,468	w.	40	nw.	14	1	4	26	8.8	4.8	0.3
Lansing	878	11	62	29.04	29.99	......	41.2	−7.5	69	18	49	23	30	33	25	38	35	84	3.44	+1.2	18	4,661	sw.	22	sw.	26	5	3	23	7.6	3.4	T.
Ludington	637	60	66	29.26	29.97	......	40.8	......	58	18	46	26	24	35	21	38	35	79	2.68	......	20	9,178	w.	44	w.	26	4	4	23	7.6	1.8	0.9
Marquette	734	77	111	29.16	29.98	− .03	38.5	−7.2	63	2	44	26	24	33	21	34	31	77	2.96	−0.2	21	8,508	w.	39	sw.	1	0	6	25	8.6	1.7	T
Port Huron	638	70	120	29.29	29.99	− .05	43.3	−6.2	67	18	50	26	31	36	29	40	37	82	2.79	+0.1	20	9,320	nw.	33	sw.	26	2	11	18	7.5	T.	....
Saginaw	641	48	82	29.28	29.99	......	42.1	......	70	18	49	26	31	35	25	38	35	80	3.46	+0.7	16	7,778	w.	29	s.	14	3	3	25	8.4	0.3	T.
Sault Sainte Marie	614	11	61	29.27	29.97	− .04	38.4	−5.0	58	18	44	19	24	33	21	35	32	81	3.09	−0.2	18	7,573	w.	34	w.	19	3	7	21	8.1	7.0	1.0
Chicago	823	140	310	29.11	30.01	− .03	45.0	−8.2	69	18	51	23	30	39	29	40	34	67	3.96	+1.4	15	9,679	w.	41	w.	26	5	5	21	7.6	1.3	0.5
Green Bay	617	109	144	29.29	29.96	− .06	39.9	−7.2	71	2	46	18	31	33	28	35	32	79	2.38	0.0	16	9,093	sw.	38	ne.	23	1	5	25	8.6	4.0	1.2
Milwaukee	681	119	133	29.23	29.97	− .06	42.4	−7.8	69	2	49	20	31	36	28	39	35	76	4.88	+2.5	13	8,803	w.	37	ne.	23	6	6	19	7.2	1.1	T.
Duluth	1,133	11	47	28.72	29.97	− .03	33.8	−11.4	56	1	40	12	23	27	21	31	29	85	2.83	+0.1	14	10,608	w.	54	nw.	11	5	7	19	7.5	4.1	....
North Dakota.							35.3	−7.0										74	0.82	−0.4										6.4		
Moorhead	940	8	57	28.98	30.02	+0.02	35.1	−7.7	75	1	44	5	23	26	33	32	29	83	0.76	−1.3	10	7,948	nw.	36	nw.	4	8	8	15	6.3	3.8	T.
Bismarck	1,674	8	57	28.25	30.08	+ .09	36.4	−7.7	79	3	48	10	12	25	42	31	25	67	0.21	−0.8	4	9,945	nw.	43	nw.	22	10	9	12	6.0	2.2	T.
Devils Lake	1,482	11	44	28.39	30.00	+ .01	32.4	−8.1	73	1	41	10	23	23	30	29	25	78	1.32	+0.1	13	9,871	nw.	50	n.	22	2	11	18	7.3	7.3	0.5
Grand Forks	835	12	89	......	......	......	32.8	......	71	1	42	2	23	24	32	....	....	....	1.15	......	11	......	nw.	49	nw.	11	12	6	13	....	6.6	0.3
Williston	1,872	41	48	28.03	30.05	+ .07	37.2	−4.7	76	3	47	13	29	27	40	32	26	66	1.00	+0.2	10	7,191	nw.	36	nw.	26	5	14	12	6.2	1.7	T.
Upper Mississippi Valley.							44.4	−8.4										70	1.95	−0.5										6.6		
Minneapolis	918	10	208	28.98	29.97	......	38.6	......	68	1	46	18	30	31	29	....	....	....	1.70	−0.8	11	10,422	nw.	46	n.	22	1	9	21	8.1	2.3	T.
St. Paul	837	201	236	29.05	29.97	−0.04	38.3	−9.8	68	1	46	18	31	32	30	....	....	....	1.68	−0.7	11	10,788	nw.	44	se.	17	1	13	17	7.7	2.3	T.
La Crosse	714	11	48	29.19	29.98	− .04	39.4	−10.5	74	2	47	18	31	32	31	....	....	....	2.64	+0.2	9	4,238	nw.	20	nw.	4	2	11	18	7.7	7.0	1.6
Madison	974	70	78	28.93	30.00	− .03	40.0	−8.8	68	2	47	16	30	33	29	36	32	77	3.08	+0.7	13	7,936	w.	46	n.	23	3	6	22	8.0	5.0	1.6
Wausau	1,247	4	....	28.60	29.96	......	36.3	......	70	2	43	18	31	30	31	....	....	....	3.12	......	18	......	se.	....	....	....	1	10	20	8.0	8.3	0.4
Charles City	1,015	10	49	28.91	30.01	− .01	39.2	−9.0	74	2	48	9	31	30	35	34	30	78	2.22	+0.2	10	5,697	nw.	25	ne.	23	1	9	21	6.9	8.9	4.0
Davenport	606	71	79	29.35	30.02	− .02	43.9	−9.7	72	4	52	21	30	36	27	39	34	71	4.00	+1.6	14	5,982	nw.	26	e.	17	5	10	16	7.0	2.2	T.
Des Moines	861	84	97	29.08	30.01	− .02	44.7	−6.8	79	2	55	16	30	34	34	38	30	60	0.92	−1.8	5	6,432	nw.	29	sw.	6	5	12	14	6.3	1.3	....
Dubuque	698	81	96	29.26	30.03	− .01	41.9	−10.1	73	2	50	20	30	34	29	37	32	72	1.87	−0.8	11	5,553	nw.	28	nw.	4	2	13	16	7.3	3.2	1.0
Keokuk	614	64	78	29.34	30.03	− .02	46.4	−8.3	79	17	56	21	30	37	37	40	34	67	1.93	−0.6	11	6,536	nw.	27	sw.	26	10	11	10	5.3	T.	....
Cairo	356	87	93	29.67	30.06	− .01	53.6	−5.5	84	15	64	28	30	44	37	46	40	66	1.42	−1.2	6	6,859	n.	32	w.	26	13	10	8	4.6	T.	....
Peoria	609	11	45	29.35	30.03	− .02	44.2	−7.8	80	17	54	21	13	35	34	39	35	78	2.23	−0.3	11	5,353	s.	28	w.	26	7	9	15	6.4	0.6	T.
Springfield, Ill.	644	10	91	29.33	30.02	− .03	47.4	−7.2	81	17	57	25	30	38	34	40	35	69	0.81	−1.8	6	6,928	nw.	30	nw.	29	6	14	11	6.2	0.2	....
Hannibal	534	74	109	29.44	30.02	− .03	47.9	−8.0	84	17	59	22	13	37	39	....	....	....	0.94	−0.7	7	7,488	sw.	33	s.	17	12	10	9	4.6	0.2	....
St. Louis	567	265	303	29.42	30.03	− .03	51.1	−7.3	85	15	60	25	30	42	34	44	38	65	1.87	−0.5	10	11,227	s.	46	se.	25	7	14	10	5.5	0.2	....
Missouri Valley.							46.0	−6.7										60	0.54	−1.4										4.8		
Columbia, Mo.	781	11	84	29.18	30.03	−0.02	48.6	−6.2	84	15	60	20	30	37	42	....	....	....	0.72	−1.7	9	6,889	nw.	32	n.	28	13	9	9	4.9	0.2	....
Kansas City	963	161	181	29.00	30.05	+ .01	50.4	−5.4	83	4	60	21	30	40	32	41	31	53	1.65	−0.6	9	10,262	nw.	46	nw.	11	17	8	6	3.7	0.8	....
St. Joseph	967	11	49	28.99	30.04	......	48.4	......	81	15	59	20	30	38	38	40	31	57	0.80	......	5	7,593	nw.	36	nw.	22	12	11	8	4.6	0.3	....
Springfield, Mo.	1,324	98	104	28.64	30.06	+ .01	50.5	−6.8	84	15	62	19	30	39	36	42	35	63	0.31	−2.5	6	9,136	nw.	36	nw.	11	17	9	5	3.6	T.	....
Iola	984	11	50	29.00	30.06	+ .02	50.6	−6.3	88	4	64	18	30	37	40	....	....	....	0.87	−1.4	5	5,661	n.	29	nw.	29	16	10	5	3.7	T.	....
Topeka	983	85	101	......	......	......	49.7	−6.6	85	4	61	20	30	38	37	....	....	....	1.15	−0.8	7	8,465	se.	37	se.	17	16	9	6	3.8	0.7	....
Drexel	1,299	10	54	28.62	30.04	......	44.4	......	82	17	57	14	30	32	39	36	28	62	0.39	......	3	8,785	nw.	40	sw.	17	9	11	11	....	T.	....
Lincoln	1,189	11	84	28.76	30.05	+ .02	46.6	−6.7	83	17	59	17	30	34	36	37	29	58	0.44	−1.4	3	8,331	n.	46	nw.	22	12	8	11	5.1	0.2	....
Omaha	1,105	115	122	28.85	30.04	+ .01	46.6	−6.7	81	17	57	19	30	36	34	38	29	57	0.55	−1.8	5	7,829	nw.	42	nw.	22	12	9	10	4.9	0.1	....
Valentine	2,598	47	54	27.32	30.08	+ .07	41.5	−7.0	80	3	56	5	23	27	46	34	28	63	0.20	−1.1	5	8,707	nw.	39	nw.	22	9	12	10	5.4	0.4	....
Sioux City	1,135	94	164	28.81	30.05	+ .05	43.0	−8.1	77	2	54	13	30	32	42	38	29	64	0.31	−1.5	2	10,706	nw.	57	nw.	22	9	14	8	5.3	1.5	T.
Huron	1,306	59	74	28.63	30.06	+ .05	39.2	−5.5	73	1	51	6	23	28	40	33	27	66	0.07	−1.3	3	9,819	nw.	49	nw.	22	3	22	6	5.8	0.1	....
Pierre	1,572	70	75	28.37	30.07	+ .06	42.9	−6.2	84	3	56	11	23	30	46	36	30	63	0.02	−0.8	1	8,589	nw.	52	nw.	22	11	6	14	5.7	T.	....
Yankton	1,233	49	57	28.70	30.04	+ .03	42.8	−7.7	75	6	54	13	30	32	41	....	....	....	0.13	−1.4	1	7,042	nw.	40	nw.	22	3	16	12	7.0	1.0	T.

TABLE I.—*Climatological data for Weather Bureau Stations, October, 1917*—Continued.

Districts and stations.	Elevation of instruments: Barometer above sea level.	Thermometer above ground.	Anemometer above ground.	Pressure: Station, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Temperature of the air: Mean max.+mean min.÷2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation: Total.	Departure from normal.	Days with 0.01 inch or more.	Wind: Total movement.	Prevailing direction.	Maximum velocity: Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow on ground at end of month.
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
Northern Slope.							43.1	−1.3										64	0.56	−0.4										5.1		
Billings	3,140	5					44.8		86	3	58	−5	29	32	49				1.03		8		sw.				13	12	6			
Havre	2,505	11	44	27.42	30.10	+0.12	41.8	−1.8	80	3	53	8	29	30	41	37	33	78	0.38	−0.1	4	6,096	sw.	37	n.	5	5	9	17	6.8	2.4	
Helena	4,110	87	112	25.90	30.14	+ .11	44.8	+0.8	78	4	56	3	29	34	36	37	30	63	0.74	−0.1	4	6,366	sw.	40	sw.	3	9	11	11	5.7	7.9	
Kalispell	2,973	48	40	27.03	30.13	+ .12	43.5	+1.0	77	3	55	9	29	32	36	38	36	68	0.54	−0.6	6	3,831	nw.	27	nw.	16	11	11	9	5.2	3.0	0.5
Miles City	2,371	48	55	27.54	30.14	+ .14	44.9	−1.6	82	3	55	12	29	35	38	38	34	73	0.72	−0.1	9	5,553	nw.	27	nw.	17	12	14	5	4.5	0.3	
Rapid City	3,259	50	58	26.65	30.12	+ .11	43.2	−3.4	81	3	56	15	29	31	48	35	26	55	0.15	−1.0	5	8,356	nw.	44	nw.	17	14	8	9	4.6	0.7	
Cheyenne	6,088	84	101	24.05	30.06	+ .05	43.3	−2.0	75	4	57	2	29	30	47	35	27	60	0.39	−0.3	4	11,473	w.	55	w.	27	13	10	8	4.5	5.8	T.
Lander	5,372	60	68	24.72	30.13	+ .09	42.8	+0.5	82	3	60	−14	29	26	56	33	24	56	0.81	−0.2	6	3,247	sw.	32	n.	19	11	14	6	4.7	8.9	2.0
Sheridan	3,790	10	47	26.18	30.14		41.0		83	3	55	−12	29	27	47	34	27	65	1.77		11	4,931	sw.	37	nw.	16	10	6	15	6.0	9.0	0.3
Yellowstone Park	6,200	11	48	23.97	30.16	+ .14	38.9	−2.6	75	3	53	−6	29	25	41	31	23	59	0.97	−0.2	9	5,579	sw.	39	s.	16	14	9	8	4.5	8.0	0.5
North Platte	2,821	11	51	27.13	30.10	+ .08	45.1	−4.9	83	6	60	9	23	30	45	36	30	64	0.32	−0.8	5	5,951	n.	33	n.	22	15	10	6	4.2	0.4	
Middle Slope.							51.3	−4.3										53	0.40	−1.1										3.6		
Denver	5,292	106	113	24.78	30.07	+0.06	49.6	−1.4	81	6	64	−2	29	35	49	38	28	51	1.41	+0.4	6	5,812	s.	45	nw.	7	13	11	7	4.3	11.7	T.
Pueblo	4,685	80	86	25.35	30.06	+ .07	49.9	−2.4	87	6	66	−4	29	33	50	38	28	52	0.51	−0.2	4	4,995	se.	34	nw.	21	15	9	7	4.1	3.3	
Concordia	1,392	50	58	28.58	30.07	+ .04	49.0	−6.4	83	14	62	16	30	36	42	39	29	54	0.30	−1.7	3	7,002	nw.	36	nw.	18	12	12	7	4.5	0.5	
Dodge City	2,509	11	51	27.46	30.09	+ .07	50.2	−4.5	89	1	65	12	29	35	47	40	32	57	0.07	−1.3	2	8,444	nw.	36	n.	17	21	7	3	2.5	0.6	
Wichita	1,358	139	158	28.59	30.04	+ .01	51.9	−6.9	88	4	64	14	30	40	40	42	31	51	0.11	−2.2	3	10,539	s.	46	sw.	21	16	10	5	3.5	0.1	
Altus	1,410	5					61.0		97	15	77	17	30	45	49				0.25		1		s.				25	3	3			
Muskogee	652	4					55.0		92	16	72	16	30	38	47				0.55		4		s.				21	3	7			
Oklahoma	1,214	10	47	28.77	30.05	+ .02	57.3	−4.0	94	16	72	16	30	43	50	44	35	52	0.02	−1.8	1	11,225	s.	48	n.	28	20	9	2	2.9	T.	
Southern Slope.							61.3	−1.1										42	0.12	−2.0										1.9		
Abilene	1,738	10	52	28.24	30.04	+0.03	63.7	−0.5	97	15	79	23	30	48	49	47	31	37	0.15	−2.2	1	8,638	s.	38	ne.	22	24	7	0	1.9		
Amarillo	3,676	10	49	26.32	30.05	+ .05	55.7	−0.4	92	6	72	15	28	40	64	42	31	50	0.34	−1.4	2	9,331	sw.	39	nw.	25	27	4	0	2.7	0.5	
Del Rio	944	64	71		30.07	+ .09	67.8	−2.1	95	5	81	32	30	55	42				0.00	−2.0	0	6,515	e.	48	nw.	29	27	4	0			
Roswell	3,566	75	85	26.42	30.02	+ .06	58.1	−1.4	90	4	76	19	30	41	56	43	28	40	0.01	−1.5	1	5,638	s.	33	nw.	1	27	4	0	1.2		
Southern Plateau.							62.8	+2.9										41	0.05	−0.6										1.0		
El Paso	3,762	110	133	26.24	29.97	+0.05	64.6	+2.2	89	1	79	34	30	50	39	47	31	34	T.	−1.0	0	7,039	e.	39	e.	8	29	2	0	0.6		
Santa Fe	7,013	57	66	23.32	29.98	+ .02	51.9	+1.9	78	4	64	18	29	40	32	38	26	41	0.19	−0.9	2	6,065	sw.	36	sw.	28	20	10	1	2.5	T.	
Flagstaff	6,908	8	57	23.45	30.02	+ .10	48.2	+3.5	78	5	67	14	19	30	55				0.00		0		e.	37	w.	28	28	3	0			
Phoenix	1,108	11	81	28.76	29.90	+ .02	72.7	+2.5	105	6	92	33	30	54	47	56	46	49	T.	−0.4	0	3,382	e.	19	s.	16	29	2	0	0.5		
Yuma	141	9	54	29.74	29.88	+ .01	76.8	+4.4	108	5	94	50	26	60	44	58	43	41	T.	−0.2	0	3,477	n.	30	n.	18	31	0	0	0.4		
Independence	3,910	11	42																													
Needles, Cal.	488	4		29.39	29.80		72.8		112	5	92	42	30	54	60				T.		0						28	2	1			
Middle Plateau.							53.2	+2.4										35	T.	−0.8										1.6		
Reno	4,532	74	81	25.60	30.11	+0.12	56.0	+6.3	87	4	74	23	29	38	46	41	26	36	T.	−0.4	0	3,293	w.	21	sw.	23	27	4	0	1.4		
Tonopah	6,090	12	20	24.20	30.08		57.8		81	5	68	26	29	48	30	41	22	26	T.	−0.8	0	4,675	w.	34	nw.	24	27	4	0	1.3		
Winnemucca	4,344	18	56	25.76	30.18	+ .13	51.7	+3.1	86	9	73	15	29	30	53	37	21	37	T.	−0.5	0	3,673	ne.	19	w.	27	25	6	0	1.6		
Modena	5,479	10	43	24.73	30.08	+ .12	51.1	+1.0	84	5	71	14	29	31	53	36	18	32	0.00	−0.8	0	6,663	w.	35	w.	27	25	5	1	1.4		
Salt Lake City	4,360	163	203	25.74	30.12	+ .11	54.2	+2.0	79	5	65	23	29	43	29	42	30	41	0.03	−1.4	2	4,973	nw.	52	n.	27	22	6	3	2.3		
Grand Junction	4,602	82	96	25.47	30.07	+ .08	52.7	−0.6	83	4	68	16	29	38	39	39	24	36	T.	−0.9	0	4,959	se.	34	nw.	26	25	5	1	1.7		
Northern Plateau.							52.0	+2.6										50	0.03	−1.2										3.6		
Baker	3,471	48	53	26.60	30.21	+ .13	48.2	+2.7	77	10	63	18	28	34	36	39	33	58	0.07	−0.8	2	4,677	se.	24	nw.	27	20	8	3	2.8	0.7	
Boise	2,739	78	86	27.31	30.19	+ .13	53.2	+2.9	81	11	67	24	29	40	35	43	33	48	T.	−1.3	0	3,196	nw.	32	n.	27	21	5	5	3.1		
Lewiston	757	40	48	29.36	30.18	+ .11	53.4	+1.6	82	6	67	26	30	39	36				0.02	−1.2	2	1,691	e.	27	w.	27	17	6	8	3.8		
Pocatello	4,477	60	68	25.58	30.12	+ .08	50.4	+2.4	82	5	64	13	29	36	39	39	26	44	T.	−1.0	0	7,074	se.	40	sw.	27	15	11	5	3.8	T.	
Spokane	1,929	101	110	28.09	30.15	+ .09	50.4	+3.1	82	4	64	21	30	37	38	41	31	50	0.08	−1.4	1	3,694	sw.	33	nw.	25	14	8	9	4.5	T.	
Walla Walla	991	57	65	29.08	30.16	+ .09	56.6	+2.9	84	4	68	26	28	45	32	47	36	48	0.01	−1.5	1	2,977	s.	25	sw.	25	17	10	4	3.4		
North Pacific Coast Region.							53.5	+1.8										60	1.00	−2.9										3.7		
North Head	211	11	56	29.97	30.20	+ .15	53.6	+0.7	77	4	58	40	28	50	23	52	51	93	0.83	−3.1	14	9,193	nw.	56	nw.	27	10	6	15	6.0		
North Yakima	1,071	4					53.5		85	4	70	20	30	37	42				T.		0		nw.				27	4	0			
Port Angeles	53	8	48	30.20	30.22		48.1		68	4	55	32	28	41	20				0.51	−2.1	9	3,909	s.	30	nw.	27	7	9	15	6.1		
Seattle	125	215	250	30.09	30.22	+ .17	52.5	+1.7	71	3	58	34	28	47	24	49	46	81	0.16	−2.7	4	4,613	n.	40	s.	26	2	8	21	7.6		
Tacoma	213	113	120	29.99	30.22	+ .18	52.4	+1.8	74	3	59	32	28	46	28	50	47	81	0.13	−3.3	6	3,515	n.	34	sw.	27	3	8	20	7.5		
Tatoosh Island	101	7	57	30.10	30.20	+ .19	50.2	+0.3	64	8	53	42	29	47	14	49	48	91	5.35	−2.6	18	11,227	e.	54	s.	1	10	6	15	6.0		
Medford	1,425	4					55.4		93	4	75	24	28	36	49				0.00		0		se.				24	5	2			
Portland, Oreg.	153	68	106	30.03	30.19	+ .13	57.3	+4.0	85	4	67	34	28	48	32	51	46	69	0.03	−3.7	3	3,575	nw.	20	nw.	16	10	19	2	4.5		
Roseburg	510	9	57	29.63	30.18	+ .10	54.9	+2.1	88	4	70	28	28	40	41	48	42	67	0.02	−2.6	1	1,248	nw.	14	n.	16	20	11	0	2.1		
Middle Pacific Coast Region.							63.0	+4.3										54	0.00	−1.6										3.4		
Eureka	62	73	89	30.04	30.11	+ .05	51.6	−1.5	82	4	57	37	31	46	24	49	47	87	0.00	−2.6	0	3,507	n.	34	n.	17	9	6	16	6.5		
Mount Tamalpais	2,375	11	18	27.58	30.02	+ .01	68.2	+9.5	87	3	74	44	16	62	20	51	35	33	0.00	−1.9	0	10,151	n.	47	n.	25	26	4	1	1.6		
Point Reyes Light	490	7	18	29.48	30.00		57.4	+2.7	90	3	64	46	31	51	36				0.00		0	9,509	nw.	42	nw.	1	9	6	16	6.4		
Red Bluff	332	50	56	29.64	29.99	+ .04	71.1	+7.3	102	3	86	45	30	56	40	53	34	30	0.00	−1.6	0	4,171	nw.	31	n.	25	27	4	0	1.1		
Sacramento	69	106	117	29.92	29.99	.00	68.0	+5.8	99	7	84	40	29	52	41	54	42	49	T.	−1.0	0	4,253	se.	30	nw.	17	30	1	0	1.0		
San Francisco	155	209	213	29.85	30.02	+ .01	62.3	+3.9	96	3	71	49	24	54	34	54	48	72	0.00	−1.3	0	5,273	sw.	33	sw.	7	13	11	7	4.3		
San Jose	141	12	110	29.87	30.02		62.6	+2.3	97	3	76	38	30	49	44				0.00	−0.9	0	2,993	nw.	24	n.	26	17	13	1	2.9		
South Pacific Coast Region.							66.5	+4.2										64	0.06	−0.8										3.2		
Fresno	327	89	98	29.63	29.98	+ .02	69.3	+4.6	99	4	85	42	30	54	37	54	41	42	0.00	−0.7	0	3,780	nw.	19	nw.	15	27	4	0	1.0		
Los Angeles	338	159	191	29.61	29.98	+ .03	68.2	+5.9	94	22	78	49	31	58	35	58	52	69	0.00	−0.8	0	3,503	sw.	15	sw.	15	16	10	5	3.5		
San Diego	87	62	70	29.87	29.96	+ .01	64.6	+1.6	81	21	71	48	24	59	25	59	56	78	0.17	−0.3	1	3,749	nw.	26	nw.	31	17	7	7	4.0		
San Luis Obispo	201	32	40	29.80	30.02	+ .03	64.0	+4.8	102	3	77	42	31	51	47	54	48	67	0.09	−1.2	2	2,312	nw.	14	n.	3	13	13	5	4.1		
West Indies.																																
San Juan, P. R.	82	8	54	29.87	29.95	+ .05	78.3		87	15	83	72	19	74	14	74	72	80	3.22	−2.9	16	6,499	se.	29	e.	2	16	13	2	4.0		
Panama Canal.																																
Balboa Heights	118	7	97	29.71	29.86		78.2		88	10	84	70	18	73	14	74	74	92	6.14	−4.2	20	4,258	nw.	23	s.	5	0	16	15	7.0		
Colon	25	30	97	29.81	29.84		79.1		88	6	84	72	25	74	14	75	74	88	7.87	−7.1	24	4,498	se.	28	ne.	6	0	13	18	8.0		
Alaska.																																
Juneau	80	11	49																													

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during October, 1917, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex	8			0.15														0.08			
Albany, N. Y	19			1.13														0.65			
Alpena, Mich	18			0.69														0.47			
Amarillo, Tex	8			0.29														*			
Anniston, Ala	29			0.74														0.56			
Asheville, N. C	19			0.69														0.29			
Atlanta, Ga	29			0.47														0.43			
Atlantic City, N. J	24	1:30 a. m.	9:30 a. m.	1.48	7:28 a. m.	7:47 a. m.	0.49	0.15	0.36	0.54	0.62										
Augusta, Ga	30			0.17														0.17			
Baker, Oreg	16			0.05														*			
Baltimore, Md	23–24			1.88														0.59			
Bentonville, Ark	28			0.32														0.30			
Binghamton, N. Y	19			0.95														0.42			
Birmingham, Ala	29			0.57														0.53			
Bismarck, N. Dak	17			0.14														*			
Block Island, R. I	30	11:25 a. m.	4:45 p. m.	1.72	12:19 p. m.	1:22 p. m.	0.17	0.09	0.17	0.20	0.24	0.29	0.37	0.46	0.53	0.60	0.77	0.93	1.05		
Boise, Idaho	25			T.														T.			
Boston, Mass	30			1.68														0.65			
Buffalo, N. Y	29			1.21														0.33			
Burlington, Vt	19			0.74														0.38			
Cairo, Ill	29			0.72														0.30			
Canton, N. Y	19			1.00														0.37			
Charles City, Iowa	17			0.54														0.19			
Charleston, S. C	27			0.32														0.32			
Charlotte, N. C	29			0.91														0.46			
Chattanooga, Tenn	29	4:50 p. m.	6:37 p. m.	0.75	5:19 p. m.	5:30 p. m.	0.02	0.31	0.53	0.55											
Cheyenne, Wyo	26			0.23														*			
Chicago, Ill	17–18			1.42														*			
Cincinnati, Ohio	18			0.51														0.47			
Cleveland, Ohio	29	2:08 p. m.	5:07 p. m.	1.05	2:47 p. m.	3:27 p. m.	0.04	0.13	0.24	0.32	0.42	0.59	0.61	0.63	0.75						
Columbia, Mo	20			0.12														0.06			
Columbia, S. C	30			0.44														0.28			
Columbus, Ohio	19			0.65														0.30			
Concord, N. H	30			1.14														0.31			
Concordia, Kans	26			0.10														0.07			
Corpus Christi, Tex	13			0.33														0.09			
Dallas, Tex	8			0.10														0.08			
Davenport, Iowa	16–17	8:40 p. m.	7:25 a. m.	1.72	1:03 a. m.	1:15 a. m.	0.54	0.30	0.60	0.64											
Dayton, Ohio	18			0.99														0.62			
Del Rio, Tex	‡			‡																	
Denver, Colo	28			0.58														*			
Des Moines, Iowa	17			0.23														0.13			
Detroit, Mich	29			0.64														0.24			
Devils Lake, N. Dak	17–18			0.68														*			
Dodge City, Kans	28			0.06														*			
Drexel, Nebr	25			0.29														0.14			
Dubuque, Iowa	17			0.54														0.48			
Duluth, Minn	4			0.28														0.16			
Eastport, Me	11			1.20														0.39			
Elkins, W. Va	19			0.79														0.39			
Ellendale, N. Dak	18			0.26														*			
El Paso, Tex	2			T.														T.			
Erie, Pa	19			1.62														0.59			
Escanaba, Mich	18			0.41														0.31			
Eureka, Cal	‡			‡																	
Evansville, Ind	18	3:20 a. m.	5:20 a. m.	0.81	4:07 a. m.	4:46 a. m.	0.05	0.08	0.16	0.26	0.31	0.38	0.51	0.59	0.70						
Flagstaff, Ariz																					
Fort Smith, Ark	28			0.07														0.06			
Fort Wayne, Ind	18			2.56														*			
Fort Worth, Tex	8			0.17														0.13			
Fresno, Cal	‡			‡																	
Galveston, Tex	26			0.45														0.45			
Grand Haven, Mich	18			0.54														0.32			
Grand Junction, Colo	1			T.														T.			
Grand Rapids, Mich	18			0.99														0.43			
Green Bay, Wis	26			0.60														*			
Hannibal, Mo	25			0.36														0.10			
Harrisburg, Pa	29–30	D. N. p.m.	D. N. a.m.	1.00	12:27 a. m.	1:14 a. m.	0.12	0.08	0.14	0.23	0.33	0.38	0.46	0.58	0.64	0.74	0.79				
Hartford, Conn	30			1.71														0.56			
Hatteras, N. C	24			0.67														0.58			
Havre, Mont	17			0.18														*			
Helena, Mont	27			0.31														*			
Houghton, Mich	17–18			1.76														*			
Houston, Tex	25			0.27														0.27			
Huron, S. Dak	17			0.03														0.03			
Independence, Cal																					
Indianapolis, Ind	18	4:50 p.m.	9:00 p. m.	0.66	6:22 p. m.	6:44 p. m.	0.04	0.17	0.26	0.46	0.53	0.55									
Iola, Kans	25			0.54														0.38			
Jacksonville, Fla	18			0.13														0.07			
Kalispell, Mont	27			0.23														*			
Kansas City, Mo	25			0.93														0.25			
Keokuk, Iowa	18			0.62														0.55			
Key West, Fla	6	2:24 p. m.	5:00 p. m.	1.46	2:48 p. m.	3:25 p. m.	0.02	0.15	0.41	0.67	0.83	0.90	1.00	1.06	1.11						
Knoxville, Tenn	19	D. N. a. m.	5:30 a. m.	1.42	2:35 a. m.	3:50 a. m.	0.21	0.16	0.27	0.32	0.34	0.38	0.41	0.46	0.54	0.61	0.68	0.83	1.03		
La Crosse, Wis	25–26			0.54														*			
Lander, Wyo	27–28			0.70														*			
Lansing, Mich	22–23			0.81														*			
Lewiston, Idaho	27			0.01														0.01			
Lexington, Ky	11–12			0.70														0.20			
Lincoln, Nebr	25			0.36														0.13			
Little Rock, Ark	25			0.60														0.41			
Los Angeles, Cal	‡			‡																	
Louisville, Ky	29			0.62														0.33			
Ludington, Mich	11			0.58														0.18			
Lynchburg, Va	29			0.58														0.50			
Macon, Ga	29			0.36														0.21			
Madison, Wis	26			1.08														0.23			
Marquette, Mich	17–18			0.88														*			
Memphis, Tenn	27			0.56														0.28			
Meridian, Miss	18			0.13														0.11			

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during month.

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for the principal storms in which the rate of fall equaled or exceeded 0.25 inch in any 5 minutes, or 0.80 in 1 hour, during October, 1917, at all stations furnished with self-registering gages.*—Continued.

Stations.	Date.	Total duration.		Total amount of precipitation.	Excessive rate.		Amount before excessive rate began.	Depths of precipitation (in inches) during periods of time indicated.													
		From—	To—		Began—	Ended—		5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Miami, Fla	27	3:40 p.m.	5:40 p.m.	0.77	3:42 p.m.	4:08 p.m.	0.01	0.36	0.47	0.52	0.55	0.64	0.68								
Milwaukee, Wis	17-18			1.62														0.49			
Minneapolis, Minn	17			0.42														0.23			
Mobile, Ala	29			0.51														0.24			
Modena, Utah	‡			‡																	
Montgomery, Ala	29			0.68														0.50			
Moorhead, Minn	17-18			0.33														*			
Mount Tamalpais, Cal	‡			‡																	
Nantucket, Mass	20			1.57														0.47			
Nashville, Tenn	29			0.82														0.59			
New Haven, Conn	12			0.61														0.42			
New Orleans, La	29			0.37														0.33			
New York, N. Y	24			2.06														0.50			
Norfolk, Va	5			0.47														0.21			
Northfield, Vt																					
North Head, Wash	26			0.12														0.07			
North Platte, Nebr	25			0.19														0.07			
Oklahoma, Okla	8			0.02														0.01			
Omaha, Nebr	17			0.15														0.15			
Oswego, N. Y	19			0.97														0.34			
Palestine, Tex	29			0.11														0.10			
Parkersburg, W. Va	19			1.87														0.35			
Pensacola, Fla	29			0.32														0.31			
Peoria, Ill	18			0.95														0.56			
Philadelphia, Pa	24			2.26														0.45			
Phoenix, Ariz	13			T.														T.			
Pierre, S. Dak	7			0.02														0.02			
Pittsburgh, Pa	19			1.51														0.34			
Pocatello, Idaho	17			T.														T.			
Point Reyes Light, Cal	‡			‡																	
Port Angeles, Wash	2			0.14														0.06			
Port Arthur, Tex	18	6:20 p.m.	8:35 p.m.	0.77	6:24 p.m.	6:52 p.m.	0.02	0.08	0.14	0.22	0.33	0.52	0.63								
Port Huron, Mich	19			0.44														0.23			
Portland, Me	30			0.94														0.46			
Portland, Oreg	16			0.01														0.01			
Providence, R. I	30			1.66														0.49			
Pueblo, Colo	7			0.10														0.07			
Raleigh, N. C	30	D. N. a.m.	6:00 a.m.	3.31	1:48 a.m.	2:53 a.m.	0.02	0.23	0.53	0.69	0.78	0.93	1.06	1.15	1.30	1.48	1.62	2.00	2.09		
					3:57 a.m.	4:55 a.m.	2.20	0.18	0.27	0.45	0.57	0.62	0.68	0.70	0.74	0.77	0.85	1.06			
Rapid City, S. Dak	7			0.07														0.04			
Reading, Pa	27			0.40														0.38			
Red Bluff, Cal	‡			‡																	
Reno, Nev	6			T.														T.			
Richmond, Va	23			0.77														0.51			
Rochester, N. Y	4			0.67														0.35			
Roseburg, Oreg	27			0.02														0.01			
Roswell, N. Mex	7			0.01														0.01			
Sacramento, Cal	1			T.														T.			
Saginaw, Mich	18			0.78														0.25			
St. Joseph, Mo	17			0.23														0.19			
St. Louis, Mo	28	8:45 p.m.	D. N. p.m.	0.84	9:42 p.m.	10:19 p.m.	0.02	0.07	0.23	0.28	0.40	0.51	0.59	0.68	0.72						
St. Paul, Minn	17			0.33														0.13			
Salt Lake City, Utah	25			0.02														0.02			
San Antonio, Tex	18			0.45														0.38			
San Diego, Cal	16			0.17														0.17			
Sand Key, Fla	26	1:25 a.m.	4:00 a.m.	1.17	1:35 a.m.	1:57 a.m.	0.02	0.15	0.51	0.80	0.96	1.03									
Sandusky, Ohio	18			0.63														0.52			
Sandy Hook, N. J	30			1.64														0.52			
San Francisco, Cal	‡			‡																	
San Jose, Cal	‡			‡																	
San Luis Obispo, Cal	15			0.04														0.03			
Santa Fe, N. Mex	7			0.12														0.10			
Sault Ste. Marie, Mich	18			0.82														0.21			
Savannah, Ga	29			0.50														0.42			
Scranton, Pa	30			2.12														0.68			
Seattle, Wash	16			0.10														0.09			
Sheridan, Wyo	27-28			0.69														*			
Shreveport, La	25	6:25 p.m.	8:15 p.m.	1.73	6:40 p.m.	7:17 p.m.	0.04	0.08	0.24	0.60	1.07	1.39	1.57	1.64	1.67						
Sioux City, Iowa	28			0.16														*			
Spokane, Wash	25			0.08														0.04			
Springfield, Ill	11			0.21														0.08			
Springfield, Mo	28			0.13														0.06			
Syracuse, N. Y	5			0.72														0.36			
Tacoma, Wash	27			0.04														0.03			
Tampa, Fla	15-16	8:45 p.m.	1:00 p.m.	2.26	11:00 a.m.	11:22 a.m.	1.66	0.05	0.16	0.33	0.48	0.56									
Tatoosh Island, Wash	1			1.68														0.29			
Taylor, Tex	18			0.71														0.45			
Terre Haute, Ind	29			1.96														0.38			
Thomasville, Ga	29			0.28														0.26			
Toledo, Ohio	18			0.81														0.48			
Tonopah, Nev	1			T.														T.			
Topeka, Kans	17			0.48														0.43			
Trenton, N. J	12			0.60														0.38			
Valentine, Nebr	7			0.08														*			
Vicksburg, Miss	25-26			0.59														0.51			
Walla Walla, Wash	16			0.01														0.01			
Washington, D. C	27			0.58														0.50			
Wausau, Wis	17-18			1.00														0.30			
Wichita, Kans	25			0.07														0.03			
Williston, N. Dak	24			0.35														0.16			
Wilmington, N. C	30			0.16														0.10			
Winnemucca, Nev	1			T.														T.			
Wytheville, Va	19			1.06														0.79			
Yankton, S. Dak	28			0.13														*			
Yellowstone Park, Wyo	16-17			0.30														*			

* Self-register not in use. † Record partly estimated. ‡ No precipitation occurred during the month.

TABLE III.—*Data furnished by the Canadian Meteorological Service, October, 1917.*

Stations.	Altitude above M. S. L.* Jan. 1, 1916.	Pressure.			Temperature.						Precipitation.		
		Station, reduced to mean of 24 hours.	Sealevel, reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Total.	Departure from normal.	Total snowfall.
	Feet.	Inches.	Inches.	Inches.	°F.	°F.	°F.	°F.	°F.	°F.	Inches.	Inches.	Inches.
St. Johns, N. F.	125	29.93	30.07	+0.16	49.8	+4.4	56.6	43.0	72	34	6.36	+ 1.01	0.0
Sydney, C. B. I.	48	30.04	30.08	+ .12	50.9	+4.4	59.6	42.2	67	32	5.90	+ 1.21	0.0
Halifax, N. S.	88	29.96	30.07	+ .07	50.2	+3.0	59.3	41.1	67	32	5.94	+ 0.39	0.0
Yarmouth, N. S.	65	29.97	30.04	+ .02	48.8	+1.2	56.3	41.4	68	29	8.00	+ 3.30	0.0
Charlottetown, P. E. I.	38	29.99	30.03	+ .07	48.7	+2.2	55.0	42.4	68	35	6.74	+ 1.84	0.0
Chatham, N. B.	28	30.01	30.03	+0.07	44.7	+1.7	52.4	37.0	64	30	9.20	+ 5.34	0.0
Father Point, Que.	20	29.96	29.98	+ .03	40.5	+0.7	46.4	34.6	64	22	6.65	+ 3.75	4.0
Quebec, Que.	296	29.67	30.00	.00	41.9	−0.5	47.6	36.2	69	30	6.69	+ 3.54	T.
Montreal, Que.	187	29.78	29.99	− .02	43.0	−1.8	49.1	36.9	64	31	6.10	+ 2.97	T.
Stonecliff, Ont.	489	29.34	29.96	− .05	40.3	−2.5	46.1	34.5	58	26	2.01	− 0.42	0.7
Ottawa, Ont.	236	29.72	29.99	−0.02	42.8	−1.0	50.1	35.6	62	26	5.71	+ 3.16	T.
Kingston, Ont.	285	29.68	29.99	− .04	45.6	−1.4	52.8	38.4	62	29	6.55	+ 3.82	1.1
Toronto, Ont.	379	29.57	29.99	− .05	44.5	−2.1	52.2	36.9	62	29	4.77	+ 2.41	0.2
White River, Ont.	1,244	28.57	29.92	− .06	30.7	−6.4	38.7	22.8	58	−1	3.31	+ 0.96	16.7
Port Stanley, Ont.	592	29.36	30.02	− .03	43.7	−4.1	51.5	36.0	61	24	5.68	+ 2.70	0.1
Southampton, Ont.	656	29.24	....	....	42.6	−3.5	49.3	36.0	67	26	3.69	+ 0.52	1.5
Parry Sound, Ont.	688	29.26	29.96	−0.05	41.3	−2.6	47.9	34.7	60	26	4.93	+ 1.01	7.7
Port Arthur, Ont.	644	29.23	29.95	− .03	35.5	−4.4	42.0	29.0	58	18	2.71	+ 0.15	3.4
Winnipeg, Man.	760	29.13	29.99	+ .01	33.2	−5.9	40.6	25.9	64	8	1.36	− 0.34	7.8
Minnedosa, Man.	1,690	28.14	29.99	+ .02	32.2	−5.6	42.2	22.3	68	−8	0.57	− 0.63	4.6
Qu'Appelle, Sask.	2,115	27.70	29.99	+0.02	33.1	−6.3	42.3	23.9	62	7	1.88	+ 0.78	17.2
Medicine Hat, Alberta.	2,144	27.71	30.01	+ .04	42.3	−2.5	53.0	31.6	76	9	1.25	+ 0.67	5.4
Swift Current, Sask.	2,392	27.41	30.02	+ .05	36.2	−5.9	46.4	26.1	70	−2	0.87	− 0.01	6.4
Calgary, Alberta.	3,428	26.47	30.05	+ .10	39.2	−0.9	50.3	28.1	80	7	1.38	+ 0.90	13.8
Banff, Alberta.	4,521	25.42	30.03	+ .08	38.1	−1.2	47.9	28.4	67	0	1.09	+ 0.07	5.7
Edmonton, Alberta.	2,150	27.69	30.02	+0.09	38.0	−3.1	47.2	28.8	76	10	0.67	− 0.03	2.6
Prince Albert, Sask.	1,450	28.42	30.00	+ .03	36.4	−0.7	46.6	26.3	68	4	0.74	− 0.09	7.0
Battleford, Sask.	1,592	28.25	30.03	+ .06	36.3	−3.3	48.2	24.4	71	−5	0.18	− 0.27	1.5
Kamloops, B. C.	1,262	28.89	30.20	+ .24	48.3	+1.3	58.5	38.1	84	26	0.41	− 0.20	0.3
Victoria, B. C.	230	29.95	30.21	+ .20	50.4	+1.2	56.7	44.0	69	37	1.02	− 1.35	0.0
Barkerville, B. C.	4,180	25.86	30.24	+0.30	35.7	−4.0	42.2	29.1	60	9	5.20	+ 2.50	23.0
Hamilton, Bermuda.	151	29.94	30.10	+ .08	74.8	+1.8	79.4	70.2	83	65	17.42	+10.71	0.0

* See Explanation of Tables in this REVIEW for July 1917, p. 388.

O

Chart I. Hydrographs of Several Principal Rivers, October, 1917.

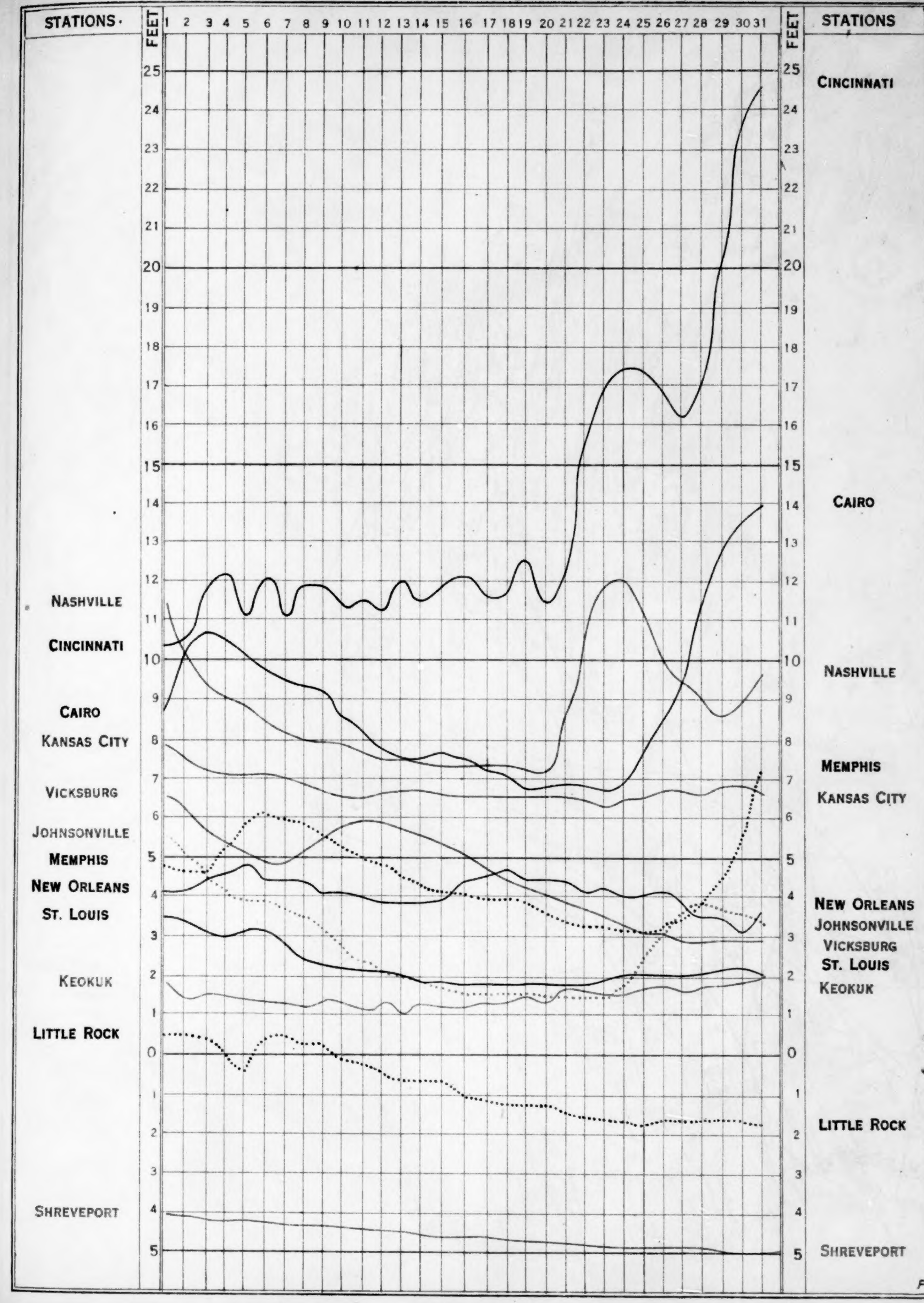

Chart II. Tracks of Centers of High Areas, October, 1917.
(Plotted by Charles A. Donnel.)

Chart III. Tracks of Centers of Low Areas, October, 1917.
(Plotted by Charles A. Donnel.)

Chart III. Tracks of Centers of Low Areas, October, 1917.
(Plotted by Charles A. Donnel.)

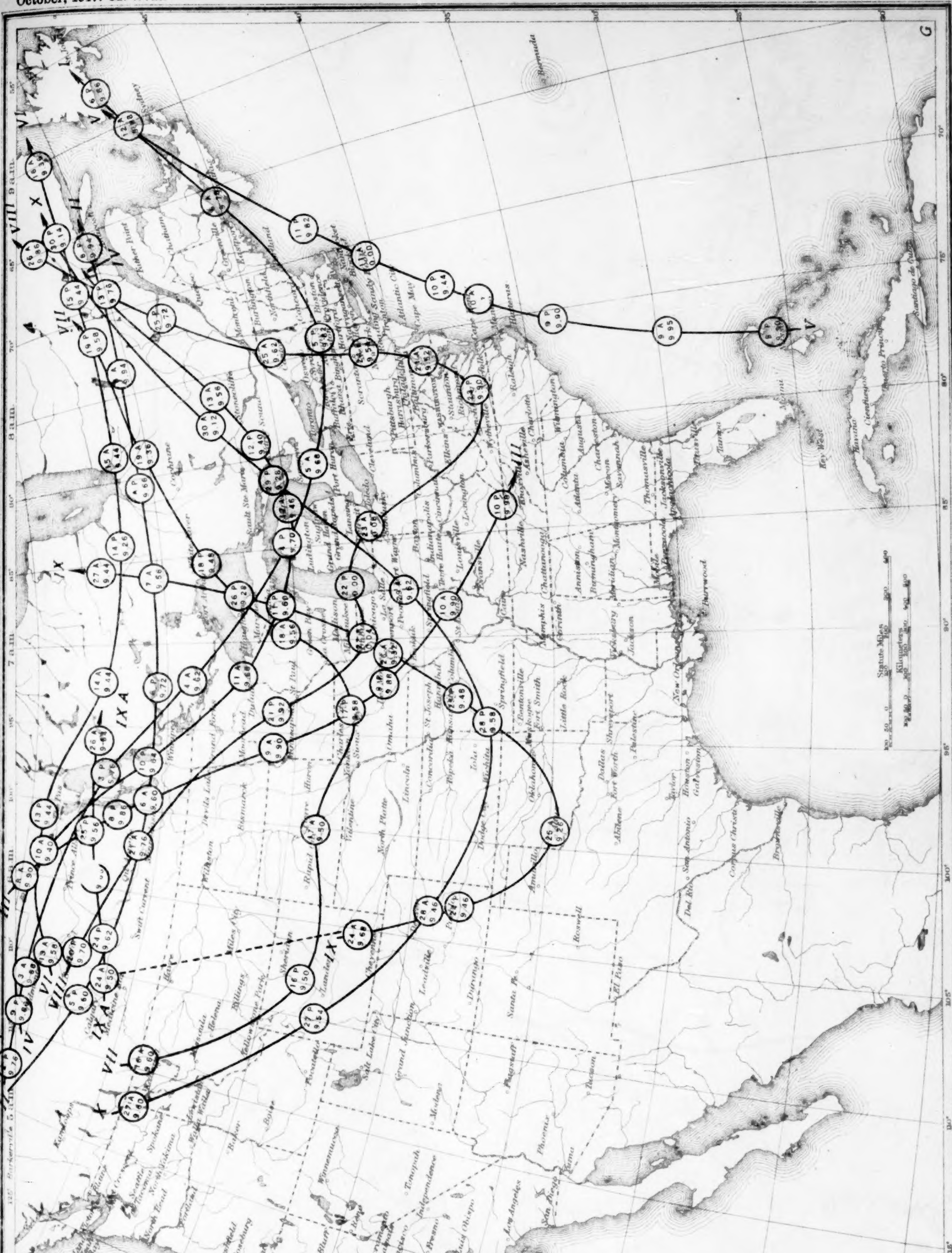

Chart IV. Departure (°F.) of the Mean Temperature from the Normal, October, 1917.

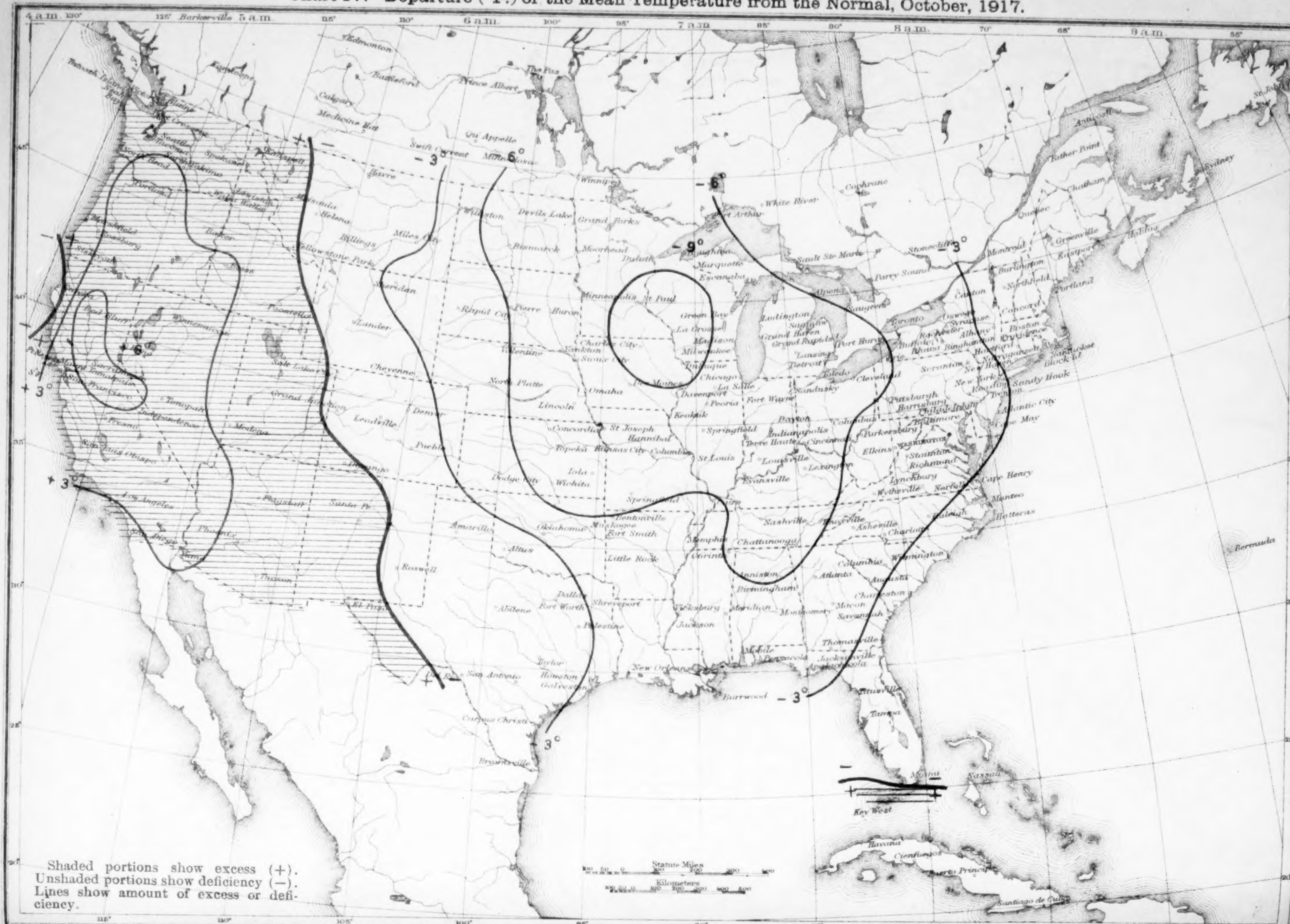

Chart V. Total Precipitation, October, 1917.

Chart V. Total Precipitation, October, 1917.

Chart VI. Percentage of Clear Sky between Sunrise and Sunset, October, 1917.

Chart VII. Isobars and Isotherms at Sea-level; Prevailing Winds, October, 1917.

Chart VII. Isobars and Isotherms at Sea-level; Prevailing Winds, October, 1917.

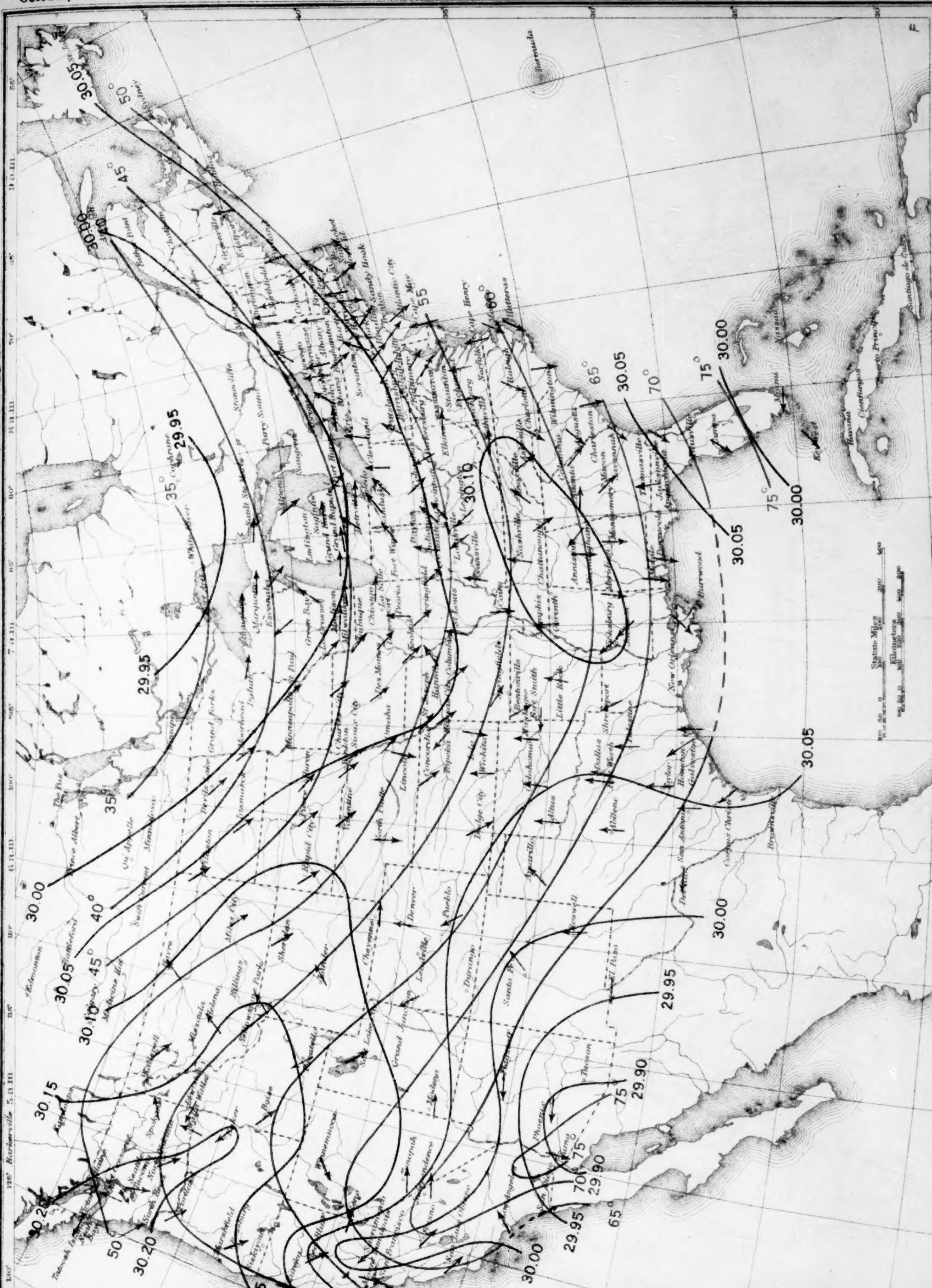

Chart IX. Means of Meteorological Data for North Atlantic Ocean, October, 1916.

(Plotted by F. A. Young.)

7 a. m., 75th meridian time.
Isobars and prevailing winds in black.
Isotherms and storm tracks in red.